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August 15, 1931
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ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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AUGUST 15, 1931

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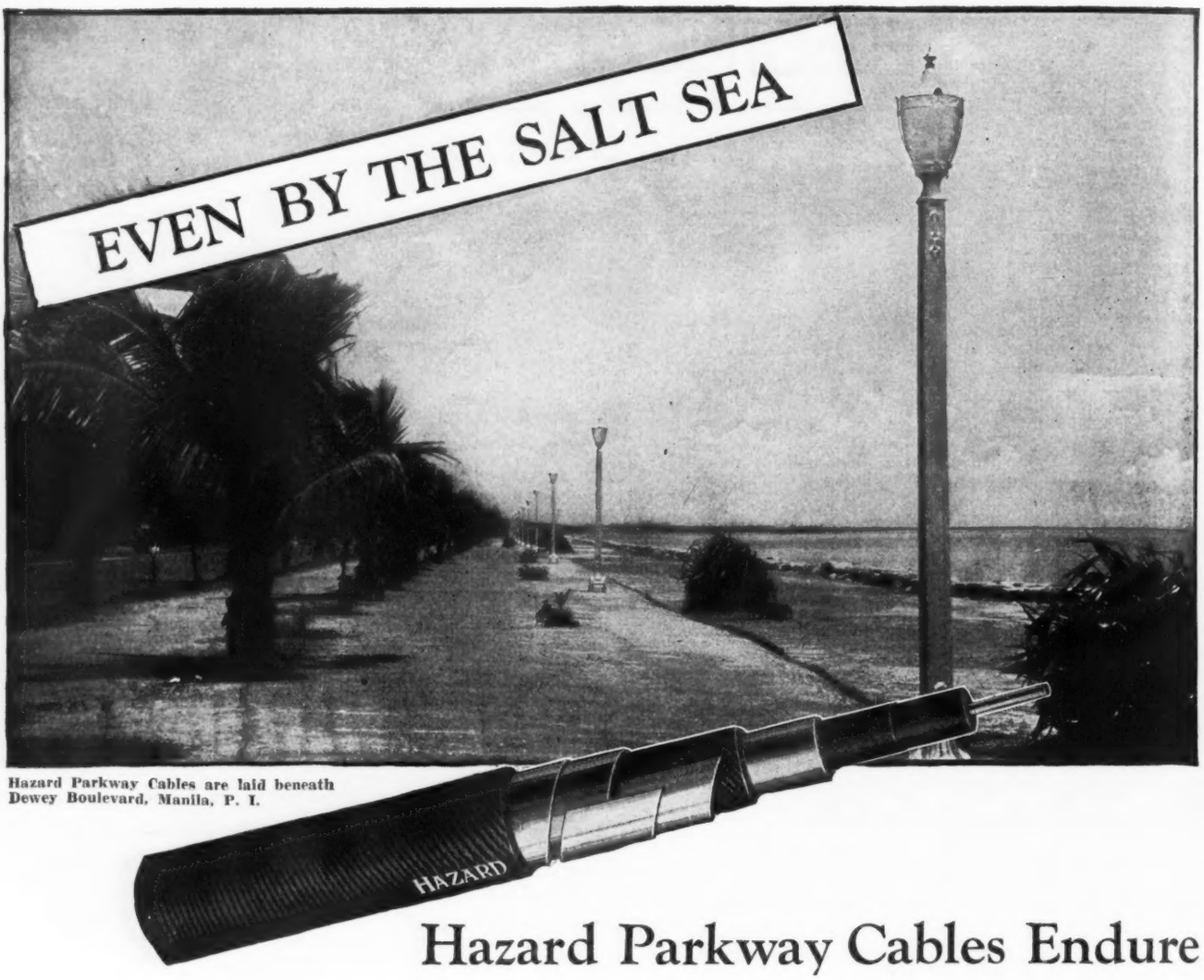

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ELECTRICAL WORLD

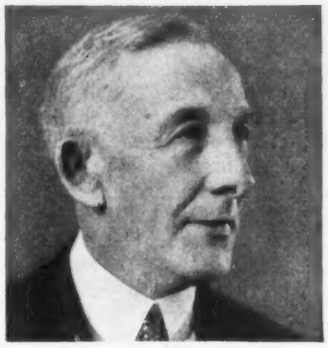
for the Week Ending

August 15, 1931

Federal Power Commission issues questionnaire

—**What has the board in mind?** Information which it seeks from licensees and their affiliate companies not only concerns financial relations but obtrudes into the field of steam-electric generation of utilities subject to its jurisdiction—*p. 266.*

—**Framing St. Lawrence treaty.** Shall it be done by an international commission or by diplomatists? In either case there must be haste if roseate predictions of New York officials concerning early beginning of work are to be fulfilled—*p. 267.*



n government we have not applied he same principles which are vital o successful business operation. nstead of naming men fitted for the work they must do, we have elected men because they belong to the same party, the same church or the same club. Under such conditions it is no wonder that here and there one will find failures, or that here and there some public official will be untrue to his trust.

LOUIS L. EMMERSON,
Governor
State of Illinois.

Is service the politician's abhorrence?

—**Public-plant men's tendency** to postpone maintenance of equipment, as well as their leaning toward keeping interest and depreciation items out of their operating statements, furnishes theme for power company expert—*p. 281.*

—**Cost "spread" of electricity** between generator and customer is analyzed in report of St. Lawrence Power Development Commission and factors that cause the differential are explained in the layman's language—*p. 289.*

—**Accord on wiring standards** between six national electrical associations is looked for as the result of a conference at the recent league gathering, Camp Co-operation XI—*p. 268.*

—**Adjusted Ontario Hydro rates** result in an average reduction of 5 mills, but in Ottawa domestic charges for Hydro and private company alike are up 60 per cent to minimum customers—*p. 270.*

Trying new ideas at Fifteen-Mile Falls

—**Many nations will take part** in the congress of the International Commission on Illumination to be held in Great Britain on September 2-19. America contributes numerous papers and will send a delegation of 25—*p. 269.*

—**Double amortisseur windings** and the use of grounding impedances on 220-kv. transmission lines are novel features that are justifying their trial on New England Power's big new Connecticut River plant—*p. 276.*

136 organizations asked for Shoals bids

Power Board's Questionnaire Includes Holding Companies and Steam Plants

FIFTEEN pages of text and blank tables are required for the previously announced questionnaire of the Federal Power Commission to its licensees and their affiliates, which was mailed on August 8. This questionnaire, Vice Chairman Ralph B. Williamson of the commission says, is "especially prepared to elicit information relative to questions of finance, management and control of such licensee companies." Mr. Williamson goes on:

A study of the control of federal licensees and their relation to the hydro-electric industry is a step in the general study of the water-power industry being made by the commission. This phase of the study is being conducted under the direction of Dr. Walter M. W. Splawn, as a special assistant to the commission.

Concurrently with this study the commission, through its engineering division, is beginning an engineering and economic study of the electrical industry with particular reference to the relations between the water-power industry and other closely related industries. This work is being done under authority conferred by Section 4 of the water-power act.

As a result of the study the commission hopes to acquire full and authentic information relative to the development and transmission of power in the hydro-electric and fuel-electric fields, both generally and as restricted to certain geographical divisions of the United States.

It will be noted that the commission does not confine the data it seeks to hydro-electric operating companies and the organizations that control them but desires also to inform itself concerning "fuel-electric fields." The range of the inquiry may be indicated by the scope of the seventeen numbered divisions of the questionnaire, some of these embracing many items. They may be summarized thus:

1. Licensee or other respondent.
2. Operations of licensees and other respondents.
3. Corporate powers.
4. Financial structure.
5. Payment for services.
6. Services rendered to licensees by other respondents.
7. Capital stock.
8. Dates in connection with stock holdings.
9. Number and voting power of security holders.
10. Control of respondent.
11. Information concerning 30 chief security holders.
12. Concerning all directors.
13. Concerning general officers.
14. Holdings or rights in securities of other companies.
15. Utility companies in which respondent has control or interest otherwise than through such holdings.
16. Reports made to federal government in last three years.
17. Latest annual report to stockholders.

The return must be delivered to the Federal Power Commission by September 15.

▼

Utility Measures Figure in Georgia's Politics

IN THE GEORGIA HOUSE last week the measure prohibiting municipalities from selling or leasing publicly owned electric light plants for a period of more than twenty years was defeated by 100 to 69. The bill provided that the sale or lease of a municipally owned plant could not be completed until an election had been held and the sale approved by two-thirds of those voting.

A measure has been passed by the Senate permitting the city of Augusta to build and maintain a municipal electric power and light plant. Amending the charter of Macon so as to permit the city to acquire and maintain a lighting plant is under discussion in the City Council of that place.

▼

Court Test for Kansas Anti-Merchandising Law

SUITS TO PREVENT enforcement of the law enacted by the 1931 Legislature to prohibit the merchandising of appliances by public utilities were filed in the Shawnee County District Court in Kansas last week, following the arrest of L. L. Roesle, sales manager for the Capital Gas & Electric Company, on a charge of selling an appliance in violation of the act. This company is a subsidiary of the Cities Service Company, and the complainants in the suit were ten gas-distributing companies embraced in the same organization. Mr. Roesle, who desired to make a test case, refused to pay the minimum fine of $100 and was released after he obtained a writ of habeas corpus.

It is alleged by the companies that the law is uncertain and ambiguous, that it deprives the plaintiffs of property rights without due process of law, that it constitutes unreasonable and arbitrary exercise of police powers, that the subject matter of the act is not clearly expressed in its title, that the act undertakes to prevent the misuse of merchandising by public utilities by pro-

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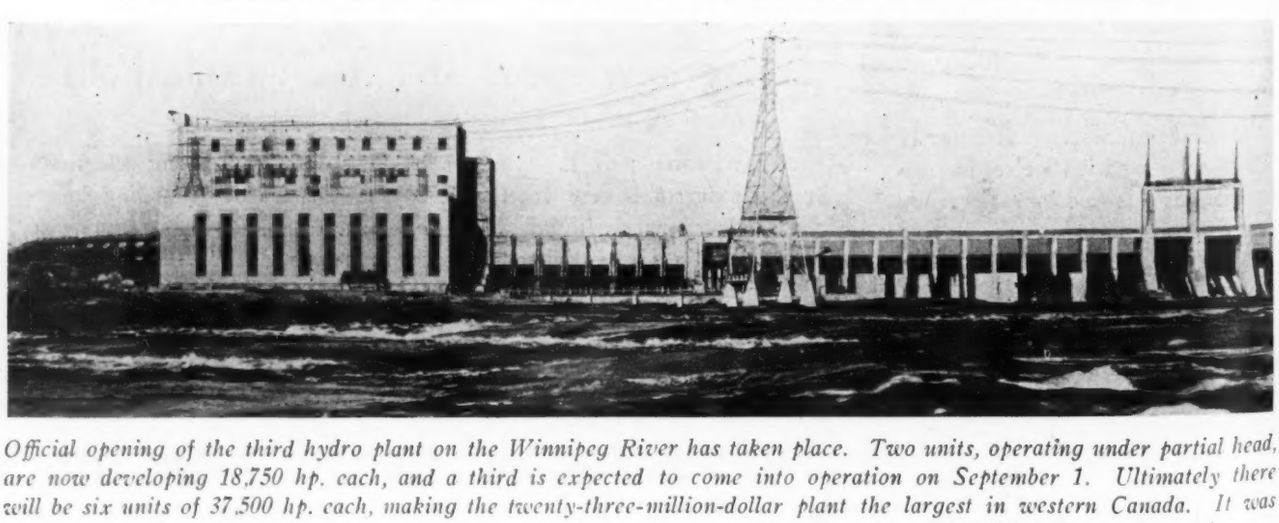
SEVEN SISTERS HYDRO PLANT ADDED TO PREDECESSORS ON WINNIPEG RIVER



Official opening of the third hydro plant on the Winnipeg River has taken place. Two units, operating under partial head, are now developing 18,750 hp. each, and a third is expected to come into operation on September 1. Ultimately there will be six units of 37,500 hp. each, making the twenty-three-million-dollar plant the largest in western Canada. It was built by the Northwestern Power Company, associate of the Winnipeg Electric and Manitoba Power companies.

THE VENICE OIL FIELD NEAR LOS ANGELES UNDER ELECTRIC LIGHT

▼ ▼ ▼

hibiting proper and lawful use of merchandising in connection with such business, that the act contains more than one subject, that it vests in the Public Service Commission powers and duties not clearly indicated in the title of the act, and that the law impairs the obligation of contracts in violation of the Constitution of the United States.

Application for an injunction will come up at Topeka on Monday, August 17.

▼

Indiana Commission Vetoes Group-Rate Plan

ENDEAVOR OF THE Insull interests in Indiana to have 68 properties in the southern part of the state served by the Public Service Company of Indiana grouped for the purpose of fixing uniform rates (ELECTRICAL WORLD, May 30, page 981) has been defeated by the Public Service Commission of that state. The question arose in connection with determining new rates for Bloomington.

By a vote of three to one, Chairman John W. McCardle being absent on account of illness, the commission refused to adopt an order presented by Commissioner Harry K. Cuthbertson, who agreed with the company's contention that all the "south system" electric consumers, "being served by the same system or unit of property, are entitled to substantially the same rates, except that the customers must be properly classified and consideration given to the size of the local distribution systems and cities."

Roosevelt Compares Long Sault and Beauharnois

FOLLOWING A TRIP to Massena Point, the proposed site of the New York State hydro-electric development on the St. Lawrence River, and a trip into Canada to visit the Beauharnois plant now being built on that river, Governor Franklin D. Roosevelt expressed himself as more than ever convinced of the feasibility and utility of the state's plans. He was accompanied on the trip by Chairman Frank P. Walsh and two other members—Delos Cosgrove and Fred Freestone—of the newly appointed State Power Authority and was met in Canada by President R. O. Sweezey and other Beauharnois Power Corporation officials. On returning from Beauharnois Governor Roosevelt said:

The Beauharnois power development is a constructive job of importance, comparable to the largest ever undertaken in any country. What is especially interesting is the comparative simplicity of the engineering problems. No dam across the St. Lawrence River is necessary, because, in effect, a new channel for the river is being diked, not dug, carrying it on a level for 15 miles to a point where it drops over a steep bank into Lake St. Louis. At this point nature provides a solid foundation of rock for the power house and the race.

Somewhat the same theory of engineering is proposed for the international development at the Long Sault Rapids. In both places the fall of the river is between 80 ft. and 90 ft., and in each place some 2,000,000 hp. will be developed.

The New York State Power Authority, acting in conjunction with the Province of Ontario or its agency, will build the Long Sault development along the same constructive methods as are used at Beauharnois. In other words, the construction is not done by a state department but by a completely independent agency, using the best of engineering and construction talent, without any of the legal red tape which surrounds purely departmental work.

All of us on this trip, including the Power Authority trustees, are more than ever convinced of the definite feasibility and clear need for the quick development by the State of New York of its power resources.

Chairman Walsh outdid the Governor in optimism, even foreseeing a possible beginning of construction "in the late fall or early winter" of this year.

▼

Diplomats May Negotiate St. Lawrence Treaty

NEGOTIATION OF THE TREATY for construction of the St. Lawrence waterway and hydro-electric development through the diplomatic representatives of the United States and Canada, rather than through a joint commission appointed for the purpose, has not been officially confirmed but appears to be probable. The Washington government leans to the commission plan of negotiation, but President Hoover is not likely to quibble on the manner of approach if the Dominion government feels that direct negotiation is the quickest means to an understanding that will permit the work to go ahead.

The Joint Engineering Board has reached substantial accord, and the decision whether there shall be a one-stage or a two-stage development, although fundamentally an engineering problem, has political implications that would be much less formidable and more quickly

reconciled by W. D. Herridge, Canadian Minister to the United States, and Hanford J. MacNider, American Minister to Canada, than by a large board of commissioners. That Canada is ready to proceed without further delay is confirmed by the report that full authority has been given by Premier Bennett to Major Herridge to initiate the negotiations. It is understood that Canada believes the present to be a favorable time to seek agreement on the project. This is in harmony with President Hoover's desire to conclude a treaty that may be presented to the Senate next December for ratification. Failure of the Senate to ratify the Niagara remedial treaty is regarded as an incentive rather than a deterrent to prompt negotiation of the treaty on the seaway as the latter will embrace an agreement on the diversion of water for power and other purposes.

▼

Board Asks 136 Firms to Bid for Muscle Shoals

BIDS FOR LEASING and operating the government properties at Muscle Shoals are to be opened at Washington on September 1 by the new commission representing the federal government, Alabama and Tennessee. An acceptable offer does not seem to be expected, Colonel J. I. McMullen, a member of the commission, explaining that the main purpose of requesting tenders is to aid in the development of a plan for disposing of the project.

None the less, solicitations for bids have been sent to no fewer than 136 firms and organizations, including light and power operating companies, holding and management companies, manufacturers, chemical firms, farmers' organizations and even investment bankers. Among these companies and associations are the Alabama Power, "Georgia Light & Power," Tennessee Electric Power, Muscle Shoals Power Distributing, Commonwealth Edison, Middle West Utilities, Associated Gas & Electric, North American, Stone & Webster, Byllesby, Harris-Forbes, General Electric, Westinghouse, Western Electric, Ford Motor, General Motors, du Pont de Nemours, Aluminum of America, Goodyear Tire & Rubber, Anaconda Copper Mining, United States Steel, American Cyanamid, Union Carbide, National Carbide and many other chemical firms, the National Grange, the Farmers' Union and the American Farm Bureau Federation.

Members of the commission believe that of all the firms and organizations that are being asked to bid, the American Farm Bureau Federation is most likely to submit an acceptable proposal.

▼

Six Associations Will Unify Wiring Standards

AMONG IMPORTANT developments of Camp Co-operation XI was a conference between representatives of six national associations to effect a meeting of minds on the setting up and coordination of an all-industry residence wiring specification. Growing out of the work of the "red seal" advisory committee of the Society for Electrical Development, this conference came to an agreement that there should be no premature publication of the specifications of any one group in advance of a general understanding.

The conference, which was held on July 29, heard a report from E. A. Brand, chairman of wiring sales committee of the N.E.L.A., who, as a result of a recent meeting of the Commercial National Section of the N.E.L.A. in Chicago, was instructed to invite representatives of all national electrical associations to a conference for the purpose of developing a set of wiring standards which would be generally acceptable. The associations represented were the N.E.L.A., N.E.M.A., S.E.D., N.E.W.A., Electragists and the Artistic Lighting Equipment Association.

Mr. Brand explained that the N.E.L.A.'s recommentation was that specifications be officially sponsored to the trade and to the public under the name of the Society for Electrical Development and that they bear the name "red seal," provided that any barriers now preventing the free use of that name can be removed and that the consent of the S.E.D. be obtained.

The sense of the meeting as brought out by the discussion was summed up by S. L. Nicholson of the N.E.M.A. as favoring a joint committee to review the specifications prepared by the N.E.L.A. wiring committee and a committee of the Association of Electragists International and for the purpose of unifying those recommendations, said committee to represent the N.E.L.A., and A.E.I. and the N.E.M.A. After these three groups have prepared a

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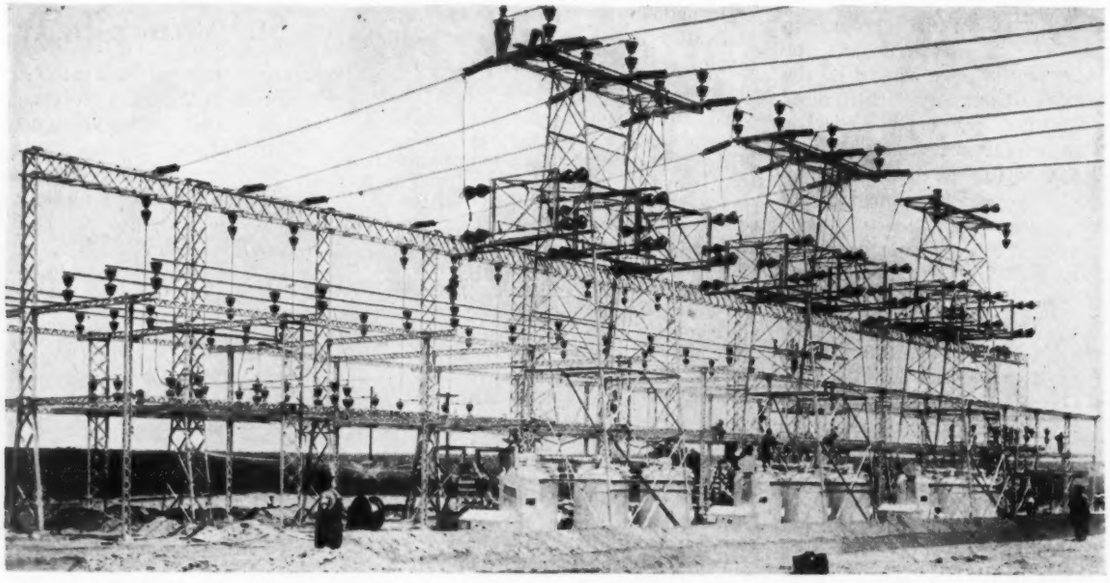
SAN JOAQUIN LIGHT & POWER CORPORATION'S HERNDON SUBSTATION



Here is the 110-kv. bus structure, with oil switches in the foreground, of this new station serving the interconnected systems of the middle California power companies.

single set of standards, they should be submitted to the other interested groups in the industry for approval and support. The responsibility for organizing the joint committee was imposed upon Mr. Brand.

▼

A. S. A. Adopts Eight Standards for Poles

EIGHT NEW STANDARDS for wooden poles, each standard covering ten classes of poles, have been approved by the American Standards Association. The range of sizes provided in each class is such that engineers should be able to make an economical selection to meet their specific requirements. Dimensions approved as American standards cover Northern white-cedar poles, Western red-cedar poles, chestnut poles and Southern pine poles. Specifications approved as American tentative standards cover the same four divisions.

These dimensions and specifications have been published as four pamphlets, each pamphlet containing the dimensions and specifications for one species of wood. Copies of the pamphlets are available at 20 cents each from the American Standards Association, 29 West Thirty-ninth Street, New York City.

▼

Many American Papers for World Lighting Congress

WITH MORE THAN one hundred papers scheduled for presentation at the eighteen-day international illumination congress and tour beginning in London on September 1, plans to make the forthcoming congress the most noteworthy in the history of the International Commission on Illumination are virtually complete, according to an announcement just made by the United States national committee through the Illuminating Engineering Society. Approximately 150 representatives from fourteen leading countries have accepted program assignments. Among the countries to be officially represented are Austria, Argentina, Belgium, Czechoslovakia, France, Germany, Great Britain, Holland, Hungary, Italy, Japan, South Africa, Sweden, Switzerland and the United States.

The American delegation, numbering approximately 25, includes central-station lighting service engineers, representatives of electrical equipment manufacturers and others interested in lighting research and practice. Those who have accepted program asignments include W. F. Little, president of the Illuminating Enginering Society; C. H. Sharp, F. C. Breckenridge, E. C. Crittenden, J. F. Meyer, I. G. Priest, J. W. Barker, A. F. Kennelly, Roy A. Palmer, H. B. Dates, Ward Harrison, M. Luckiesh, H. H. Magdsick, A. L. Powell, G. S. Merrill, F. K. Moss, G. H. Stickney, D. C. Young, L. A. S. Wood, S. G. Hibben, H. H. Higbie, A. D. Moore, K. Y. Tang, F. C. Hingsburg, H. P. Gage and K. W. Mackall.

A special train will be made available for members throughout the tour, which will include visits to points of interest to lighting engineers as well as historic and picturesque sections of England and Scotland. After a few days in London the tour will proceed to Glasgow, Edinburgh, Buxton, Sheffield, Birmingham and Cambridge. Sessions of the congress will be held at various cities, the first at the Royal Technical College at Glasgow, succeeding ones at the University of Edinburgh and at Trinity College, Cambridge, where the plenary sessions will be conducted during the last week of the congress. The delegates will return to London September 19 in time to attend the three-day Faraday centenary celebration, which includes a meeting of the British Institution of Electrical Engineers and will be followed by the annual meeting of the British Association for the Advancement of Science.

The members of the United States national committee are: President, E. C. Crittenden, United States Bureau of Standards, Washington; secretary-treasurer, G. H. Stickney, Nela Park engineering department of the General Electric Company, Cleveland, and representatives from the A.I.E.E., I.E.S., N.E.L.A., American Physical Society, Bureau of Standards and the Optical Society of America. A. L. Powell is chairman of the American committee supervising contributions to the papers program of the congress.

FLOODLIGHTING LONDON

—*Wide World Photos*

In preparation for a greater display to be made in September at the time of the Faraday centenary celebrations and the International Illumination Congress the first attempt to floodlight London on an extensive scale was recently made, to the delight of thousands of onlookers. The tower of the Parliament Buildings was conspicuous.

▼

Maine Insull Interests Ready for Expansion?

ABOUT 28 UTILITIES—light and power and water companies—operated chiefly in Maine have, press reports say, become affiliated with Insull interests through the organization of a new holding company, the North Eastern Public Service Company, affiliated with the New England Public Service Company, of which Walter S. Wyman is president. No confirmation of the report was forthcoming at that company's Augusta headquarters.

These companies, the report says, capitalized at about $2,500,000, serve more than 50 communities in Maine, New Hampshire, Massachusetts and Connecticut. The new control contemplates extensive improvement in the service of the companies, which are those once included in the Maine State Water & Electric Company and the Eastern States Public Service Corporation.

The utilities had formerly been under the control of the Atlantic Public Utilities Company. The Maine State Water & Electric Company, after merging the various Maine companies, which were at one time operated independently, sought authority for a bond issue more than a year ago from the Maine Public Utilities Commission, but this was refused.

The electric companies involved are listed as those in Caribou, Dennistown, New Sweden, Livermore Falls and Turner, and the Colby Light & Power Company. These are all in Maine.

ONE OF THE HAZARDS OF THE ELECTRICAL INDUSTRY

New York Power & Light engineers and workmen had a job laid out for them in speedily restoring service when on August 3 a wind and rain storm of cyclonic proportions hit Saratoga Springs, N. Y. The damage done to power and telephone lines by falling trees in two hours was equal to that of the two-day sleet storm in the same region in December, 1929.

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Ottawa Hydro Charges Up, Rates Elsewhere Changed

A READJUSTMENT OF THE domestic lighting rate went into effect in the city of Ottawa, Canada, on August 1, with an increase of about 60 per cent to the minimum consumer. The changes announced by the Hydro and the Ottawa Electric Company, the two concerns serving the city, were identical, with the exception that the Hydro changed its system of billing on the basis of a floor-area rate to the straight service charge.

The previous rate in Ottawa called for a fixed charge of 3 cents per 100 sq.ft., with a minmum of 30 cents net per month. The new charge is 33 cents gross per month for less than 2,000 watts of connected appliances and 66 cents gross per month for more than 2,000 watts. The energy charge was previously based on 3 kw.-hr. per month per 100 sq.ft., or a minimum of 30 kw.-hr., at 2 cents per kilowatt-hour, the next 30 kw.-hr. being charged at 1 cent. The new rates call for 60 kw.-hr. at 2 cents, with the next 60 kw.-hr. at 1 cent and 0.5 cent per kilowatt-hour for additional consumption.

The effect of the new rate on a customer with the minimum 100 sq.ft. using 120 kw.-hr. per month will be to increase his present monthly bill from $1.50 to $2.40 or his average cost per kilowatt-hour from 1.25 cents to 2 cents, an increase of 60 per cent.

The distribution of electricity for domestic purposes within the boundaries of Ottawa is fairly evenly divided between the Hydro and the Ottawa Electric Company, but the private enterprise enjoys a wide patronage outside the city, its service being extended to virtually the whole population of Hull, on the opposite side of the Ottawa River, and to several outlying municipalities. The Ottawa Hydro serves only customers living within the city boundaries.

The provincial Hydro also has announced an increase in the service charges to domestic consumers in other centers throughout the Province of Ontario. The new charge, which represents a combination of the service charge and the demand charge, applies to all communities with the exception of Ottawa, Port Arthur and Niagara Falls. The charge calls for the payment of 33 cents per meter per month by consumers whose installed capacity is under 2,000 watts. Consumers who have an installed capacity of 2,000 watts or over must pay 66 cents per meter per month. The previous charge was 33 cents per meter per month irrespective of the demand of the individual consumer as measured by his installed capacity.

With regard to energy rates, the annual report of the Hydro Commission reveals that in approximately 40 per cent of the communities served by the system the rate for the first monthly energy block has been cut on the average by 0.5 cent per kilowatt-hour.

Commercial light users in the city of Toronto will soon be treated to their first major rate reduction since 1911, if plans submitted for approval to the provincial Hydro Commission are approved. The drop will involve a 12 per cent reduction for alternating current used for commercial lighting and is estimated to bring about an annual saving of $300,000 to users. An important feature is that the commercial reductions will probably be effected without any proportionate raising of the rates for domestic consumers.

▼

Scattered Happenings in the Electrical Sphere

UNITED STATES

Pennsylvania Road Laying Conduits

Work on the installation of conduits for the electrified section of the Pennsylvania Railroad between Washington and Wilmington, Del., has begun. The cost, including cables, will be about $7,000,000, and laying of the conduit will occupy about 1,000 men. The work is expected to be finished in January.

Southwick (Mass.) Municipal Plant Sold

Electrical distribution in Southwick, Mass., will soon be provided by the Lee Electric Company, subsidiary of the Western Massachusetts Companies, the sale of the municipal lines for $50,000 having been approved by the Massachusetts Department of Public Utilities. Improved service will be furnished from the Cobble Mountain hydro plant.

Theater Sues to Compel D.-C. Service

Suit has started by Earl Carroll, New York theater proprietor, to compel the New York Edison Company "to restore and continue" a supply of direct current to his theater. Rating it as a new building, though two former walls are still part of it, the company had applied its policy of extending its alternating-current system. Carroll claims that his business requires direct current and that such current is still furnished to at least sixteen competitors of his in the theatrical district.

Power Conference for Kansas City

From September 7 to September 11 a Southwest Power Conference will be held at Kansas City, with participation by the A.I.E.E., N.E.L.A., A.S.M.E., A.S.C.E. and other national bodies. It will open with a joint meeting, the first gathering to be held in the auditorium of the new Kansas City Power & Light Company office building, which is now complete except for the finishing details. Simultaneously the Southwest Power and Mechanical Exposition will be in session at Convention Hall. A subcommittee of the general power committee, Commercial National Section,

N.E.L.A., will take part in sessions concerned with oil pumping, production and refining.

Progress of Lamoka Power Corporation

The Tri-State Oil & Gas Corporation of Elmira, N. Y., has obtained a one-third interest in the Lamoka Power Corporation. The Tri-State corporation will generate electricity at the Lamoka electric plant on Keuka Lake, delivering it to communities in central New York, and will furnish 3,000,000 cu.ft. of gas daily as fuel for the generating plant. Water power will be utilized at night. The Lamoka Power Corporation, which is spending approximately $1,000,000 on its project, will furnish energy to the Associated Gas & Electric Company under a seventeen-year contract.

City Wants No Hoover Dam Power

Citizens of San Bernardino, Calif., voted recently to withdraw from membership in the Metropolitan Water District of Southern California and also rejected a proposal that the city contract with the federal government to purchase electric power from Hoover Dam. The vote on the first proposal was: To withdraw, 3,052; no, 972. On the power purchase proposal the vote was: Yes, 1,048; no, 2,896. San Bernardino was among the first cities to join the water district and also was included in a group of southern California cities, other than Los Angeles, originally designated by the federal government as Hoover Dam power allottees.

Westchester, N. Y., Wants Lower Rates

Efforts are still being put forth to assure lower residential rates for customers of the Westchester Lighting Company, which serves a large territory in Westchester County, N. Y., to the north of New York City, including Mount Vernon, New Rochelle, White Plains, Peekskill and other populous places. According to a report by Benjamin Cohen, a rate expert, to a commuters' association, the present rate of $1 for 100 kw.-hr. and then 9½ cents a kilowatt-hour brings the company a very excessive profit, and a reduction of 2½ or 3 cents is demanded. The company's rates are now up for review by the Public Service Commission at the instance of New Rochelle.

Salt Lake City Has New "White Way"

Spectacular new street lighting on Lower Main Street, Salt Lake City, comprises 112 large Westinghouse units mounted on cast-iron brackets surmounting trolley poles and equipped with 15,000-lumen lamps. Sixteen of the 56 standards carry one all-night and one midnight lamp and each of the remaining standards two midnight lamps. All previous lamps, brackets and wiring were removed by the Utah Power & Light Company.

More Energy for Oil-Field Territory

The Southwestern Gas & Electric Company of Shreveport, La., will construct a 30,000-hp. substation at Overton, Tex., for the purpose of transforming high-voltage power to be purchased from the Texas Power & Light Company and transmitted over the latter's coming line from Trinidad to Overton. This will bring to this last Texas oil territory two-way service—from Shreveport and Trinidad.

Missouri Inquiry Into Doherty Rates

Audit, appraisal and inventory of the City Light & Traction Company of Sedalia, Mo., for the purpose of fixing rates in that city, has been ordered by the Missouri Public Service Commission. The company is a Cities Service property.

Work Suspended at Hoover Dam

A strike of 1,400 Hoover Dam workmen at the end of last week led to suspension of the initial work on that project, including the diversion tunnel.

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Coming Meetings

American Institute of Electrical Engineers—Pacific Coast Division, Lake Tahoe, Calif., Aug. 25-28; district meeting, Kansas City, Mo., Oct. 22-24.

Rocky Mountain Division, N.E.L.A.—Stanley Hotel, Estes Park, Colo., Sept. 2-4. G. E. Lewis, 367 Gas & Electric Bldg., Denver.

Electrochemical Society — Hotel Utah, Salt Lake City, Sept. 2-5. C. G. Fink, Columbia University, New York.

Southwest Power Conference—Kansas City, Sept. 7-11. A. L. Maillard, 1330 Grand Ave., Kansas City.

Pennsylvania Electric Association — Bedford Springs Hotel, Bedford Springs, Pa., Sept. 9-11. H. A. Buch, Telegraph Bldg., Harrisburg, Pa.

Empire State Gas and Electric Association—The Sagamore, Bolton Landing, Lake George, N. Y., Sept. 10-11. C. H. B. Chapin, Grand Central Terminal, New York.

International Association of Electrical Inspectors—Eastern and Western Sections (joint meeting), Pittsburgh, Sept. 14-17. R. W. E. Moore, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

American Welding Society — Copley-Plaza Hotel, Boston, Sept. 21-25. M. M. Kelly, 33 W. 39th St., New York.

New England Division, N.E.L.A.—Poland Springs House, South Poland, Me., Sept. 28-30. Miss O. A. Bursiel, 20 Providence St., Boston.

Great Lakes Division, N.E.L.A.—French Lick Springs Hotel, French Lick, Ind., Oct. 1-3. T. C. Polk, 20 N. Wacker Drive, Chicago.

Association of Electragists International—Hot Springs, Ark., Oct. 5-8. L. W. Davis, 420 Lexington Ave., New York.

Illuminating Engineering Society—William Penn Hotel, Pittsburgh, Oct. 13-16. E. H. Hobbie, 29 W. 39th St., New York.

National Association of Railroad and Utilities Commissioners — Jefferson Hotel, Richmond, Va., Oct. 20-23. J. B. Walker, 270 Madison Ave., New York.

Wisconsin Utilities Association—Commercial Section, Oct. 22-23. Hotel Loraine, Madison. J. N. Cadby, 135 W. Wells St., Milwaukee.

The superintendent for the Six Companies, Inc., which has the contract, said he did not know when work, which has been conducted under conditions of great heat, would be resumed, but that the contractors were already six months ahead of schedule. The government is not concerned in the trouble.

New Oklahoma-Arkansas Link

A 66-kv. transmission line to extend the system of the Public Service Company of Oklahoma from Wilburton 52 miles to the Arkansas state line is under way. It will connect with the Southwestern Gas & Electric Company, serving Arkansas communities, and will afford another important safeguard for electric service in eastern Oklahoma and western Arkansas.

Puyallup, Wash., Wins Its Case

Victory has been won by the city of Puyallup, Wash., in the United States Circuit Court of Appeals in San Francisco in its efforts to acquire the power plant of the Puget Sound Power & Light Company at the figure agreed on by a jury in the United States District Court in Seattle. The appeal sustained the valuation of $216,825.

New Plant for Abilene, Tex.

Plans are entertained by the West Texas Utilities Company to construct a power plant at its proposed water reservoir near Abilene. The plant is to have an ultimate rating of 60,000 hp.

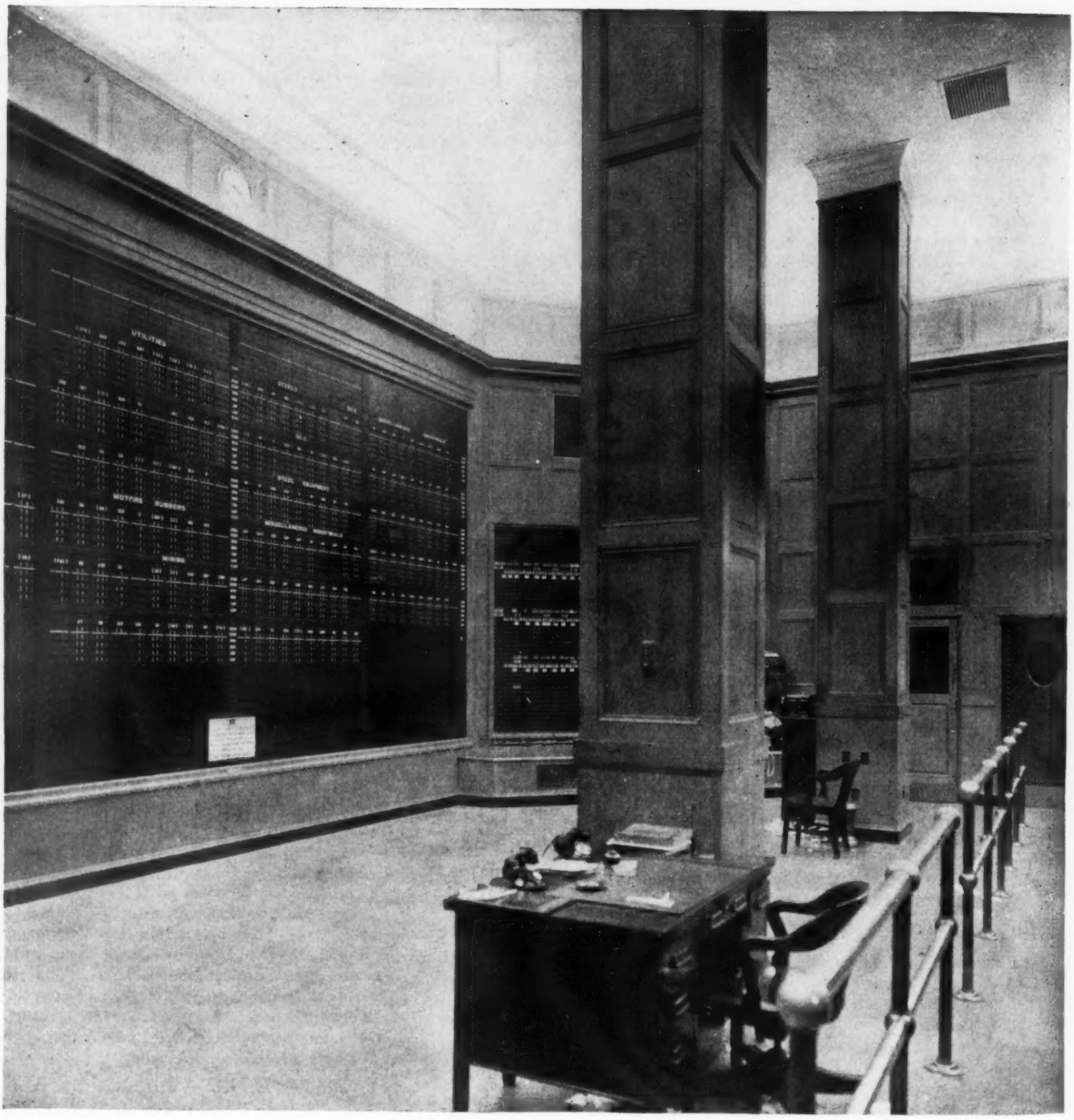
CANADA

Campbell River Plans Attacked

Once again opposition is being voiced to the proposal of the British Columbia Electric Railway Company to develop the hydro-electric power resources of the Campbell River near the northern end of Vancouver Island. Vancouver Island boards of trade have made joint protest against this being done in Strathcona National Park, and as a result the provincial government has now announced that it will make a thorough investigation of the matter.

Abitibi Plant Enters Second Stage

The big Abitibi Canyon hydro development of the Ontario Power Service Corporation, is entering the second main phase of construction. The first stage has been completed in the unwatering of the dam site. The entire flow of the Abitibi River is now being carried around the power site in two tunnels. Work is also nearly completed on the retaining walls and wing dams. The canyon of the Abitibi River is being blocked by a dam which will give a head of water for power development of 240 ft. The power house will contain five turbo-generator units, each of 55,000 hp. It is expected that the entire development will be completed by October 1, 1932.



An advance in light and communication engineering

Notable improvements in transmitting and displaying information are embodied in the new self-indicating stock quotation board installed for Hayden, Stone & Company, Boston. To facilitate reading teleregister indications originating in New York the board room is illuminated by 135 75-watt lamps mounted on 9-in. centers in a chromium reflector set into a cove near the ceiling

EDITORIALS

L.W.W.MORROW
Editor

Standards that do not stifle progress

STANDARDIZATION of engineering assemblages to the extent where further progress in improvement is handicapped is as obnoxious to users of equipment as it is to competitive manufacturers. But it is desirable to bring about such standardization as will permit direct comparisons of performance and price. Furthermore, great variety in over-all dimensions or provisions for attachment to other equipment is a handicap to application, and anything that can be done to minimize these differences is desirable.

Consequently, the new N.E.M.A. switchgear standards, which seek to remove some of the obstacles imposed by unnecessary individuality in design of such structures, are warmly welcomed. The minimum separation of live parts and the examination of breakdown values to ground and across gaps are some of the problems that have been tackled.

The new standards are predicated on the desirability of surges going to ground over the insulating units in preference to jumping the gap to the other terminal of the switch. A 15 per cent margin has been adopted as adequate insurance of the preferred breakdown. It establishes the minimum distance between live parts in terms of the equivalent needle-gap requirements for separation from ground. After allowing for cap diameters required for maximum mechanical stresses, it enables standardization of spacing between insulator axes. Accepted good practice provided the foundation for the phase separation of the various types of bus supports, hook and gang disconnecting switches and horn-gap switches, the last named, of course, carrying greater values throughout.

Once again has standardization demonstrated its potentiality for reducing the multiplicity of designs which grow up in a new industry where the personal element of opinion rules until experience and research provide a sounder alternative. In this instance there should be little fear that elimination of some varieties will impede progress toward introduction of better arrangements of switch members as further experience and ingenuity evolve new ideas.

Whose method is best for frequency control?

SOME operators of systems involved in regional interconnections maintain that there is no problem of frequency control—that the very magnitude of interconnections tends to stabilize frequency. There are others who say that interconnected frequency can be maintained the same as before interconnection by each system regulating frequency regardless of what others are doing.

However, those operators who have the opportunity to observe interconnected operation as a whole, and especially tie-line loadings, maintain that independent attempts to control frequency are about as futile as the independent efforts of several men driving separate horses attached to the same wagon to control the speed of the wagon.

One method that attempts to centralize and coordinate control of system frequency is to select one station which has sufficient capacity to absorb or release loads which will tend to raise or lower the speed of remaining generators on the system and then have other interconnected systems control their systems so that the tie-line loadings on

the side adjacent to the major frequency controlling station remain at desired values. This method leaves frequency regulation to one station, but puts the responsibility for maintaining load allocation on each component of the interconnected system.

In addition there are the advocates of automatic frequency control for single stations or for a number of stations strategically spread over the interconnected group. No tangible proof of the superiority of any particular system of regulating frequency has been presented, and yet there should be some unanimity of opinion with so many companies interconnected and with different groups working in parallel at different times, often with unnecessary seesawing of tie-line loads, especially during abrupt change-of-load periods. It seems as though there should be a concerted effort to compare methods of frequency control with evidence to show which methods are most effective with the least effort, supervision or overhead expense.

Local co-ordination in merchandising

WHETHER each sales outlet in a local community makes or loses money determines merchandising relations very largely. A good bank balance is conducive to contentment and happiness. And whether a local sales outlet makes or loses money is within the control of the individual business—it depends upon the knowledge and competency of each organization. No agency can wipe out the deficit where one exists.

Success in modern distribution requires the establishment of intelligent sales policies and practices that are fixed by market facts and conditions. Each local sales outlet must work out the modern distribution problem in miniature as applied concretely to its business. And, in addition, the local outlets must work together to establish the community principles and practices. In teaching terms, the need in modern merchandising is education in distribution.

Here is where the electrical leagues can help. They should supply a work sheet or check sheet whereby each outlet can find its own business weaknesses. They should afford a forum for the open discussion of definite distribution problems and for the working out of a better solution of community merchandising. This program may take two or three years, but work on it should be started. Good merchandising practices and relations will follow self-analysis and self-education in each local community.

Rating the lighting performance of street lamps

APPROACH of the triennial sessions of the International Commission on Illumination seems likely to revive among lighting engineers of all countries the discussion of the mid-point rating of street lighting which some of the British engineers so persistently advocated for standardization at Saranac in 1928. While Great Britain's efforts did not meet much response from other countries, it appears evident that her representatives will make another attempt in 1931.

The idea of rating street illumination in terms of the foot-candles at the point half-way between lamps sounds rather plausible. Essentially the same principle was recommended in 1907 and 1908 by a committee studying the problem for the N.E.L.A. This was known at the time as the X rating. About 15,000 observations were made on streets in a period of more than a year, but the rating did not appeal to any one having the practical problem in hand, and the idea was never carried very much further than the printed report.

It was believed at that time that no light distribution could be produced which would cast too large a proportion of the light of a street lamp at this mid-point, say 100 to 300 feet from the lamp. Later, when the prismatic glass refractor first made it practicable to approximate this distribution, the results were disappointing, and it was found necessary to redesign the refractors to avoid that extreme. Still later, when more systematic studies were made of seeing ability under various kinds of street lighting, the fallacy of equal illumination all over a street became even more apparent, particularly when lamps were widely spaced and the amount of light available approached the lower limit.

These studies brought out some interesting relations. For example, when viewed from a driver's seat, it was found that the points at which the brightness of street surface was least were not usually those at which the foot-candles were

minimum. Further, given a low amount of light, it was easier to see objects in the street, by silhouette vision, when there were periodically spaced bright areas than when the light was so distributed as to approach uniformity of foot-candles. With the practical methods of street lighting the advantage of such variation persists to surprisingly high levels. The wide-angle distribution necessary to attain comparative equality of illumination also produces glare.

In regard to these last two elements artificial street lighting is at a disadvantage as compared with full moonlight, under which, because of its directive characteristic and the absence of glare, it is possible to see with a low level of evenly distributed illumination.

With the higher levels the mid-point illumination is not likely to be a criterion. There is plenty of light everywhere to facilitate safe travel. In any event, any foot-candle measurements need to take into account the illumination on all parts of the street and often on building fronts as well.

Thus American practical experience as well as scientific investigation indicates that any mid-point measurement is of little value and is likely to lead to incorrect interpretation of lighting values and to encourage the development of less effective types of light distribution. It would, therefore, be unfortunate for the street-lighting art if our British friends were to be able to obtain international recognition of this form of rating.

Standardizing on 115 volts

CLOSE approach to the general adoption of 115 volts as standard for low-tension service throughout the United States is evident from the compilation recently issued by the lamp committee of the National Electric Light Association. A glance at the lists of communities served in the several states reveals column after column at this voltage. Rarely does 110 or 120 appear to break the uniformity.

The interruptions are just frequent enough to make it advisable to consult the lists whenever the voltage needs to be definitely known. Strangely enough, comparison with a similar list published three years ago shows a number of changes away from 115 volts, for instance, in California.

In the new arrangement each state list is separate. This should be a convenience to persons interested in the services only of a single state or small group of states, and such users are probably in the majority. It also makes revision easily possible.

The gradual change from diversity to uniformity has come in response to progress in manufacturing technique. When our light source was the carbon lamp slight variations in the product were unavoidable. Lighting companies were encouraged to spread their voltages, so that the whole output of lamps might be utilized without sacrificing life or efficiency. The accuracy attained in the manufacture of tungsten filaments has done away with these variations. What was once a convenience is now a handicap; odd voltages, then desirable, have almost disappeared.

"A ten weeks' course"

"TO SUPPLEMENT the practical experience which the prisoners have thus secured, ten weeks' courses have been offered them in carpentry, masonry, plumbing and steam fitting, electrical engineering and automobile mechanics." This quotation is from the *Atlantic Monthly* for August, 1931, and is found in an article, "Science Goes to Prison," written by Ralph P. Holben, assistant professor of sociology and criminology at Dartmouth College. It would be preposterous, of course, to infer that the editors of the *Atlantic Monthly* and their valued contributor have acquired their ideas as to what constitutes an educational preparation for the practice of electrical engineering from the blatant advertisements of shady correspondence schools. Yet Mr. Holben's article uses the same words that appear in many such advertisements—"ten weeks' course in electrical engineering."

Is it remarkable that among the professions engineering is the one least deferred to, and that among engineers the electrical engineer most lacks respect, when a contributor to and the editors of a magazine published for thinking people reveal a mental state exactly the same as that which in uneducated youth is appealed to by misleading advertisements? Mr. Holben should know and the *Atlantic* editors should know that the elements of a profession can hardly be inculcated in ten weeks in boys of apprentice age. Yet convicts, presumably, receive the degree of E.E. after ten weeks' study in a prison school!

Designing Fifteen-Mile Falls 220-Kv. System for Stability

By H. H. SPENCER
Protection Engineer
New England Power Association, Boston, Mass.

—Pioneer installation of double amortisseur windings.

—First use of grounding impedances on 220 kv.

—High-speed breakers reveal value.

—Power oscillations damped out on all tests in two seconds maximum.

THE importance of service continuity from Fifteen-Mile Falls induced the engineers of the New England Power Association to make a comprehensive study of stability in conjunction with the system design. The dual purpose was to permit the maximum power developed by the waterwheels to be transmitted to the receiver system in the steady state after the transmission capacity had been reduced by the loss of a section of one of the two circuits, and to insure against loss of synchronism between the generating and receiver systems in case of short circuit.

The project consists of three plants located on the upper reaches of the Connecticut River near St. Johnsbury, Vt. The ultimate kva. capacity will be slightly in excess of 300,000.

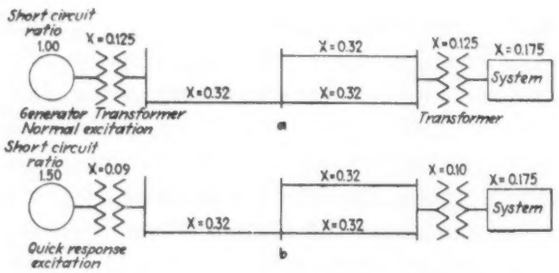


Fig. 1—Values of reactance applied to system

(a) Conventional design. (b) Used in Fifteen-Mile Falls design

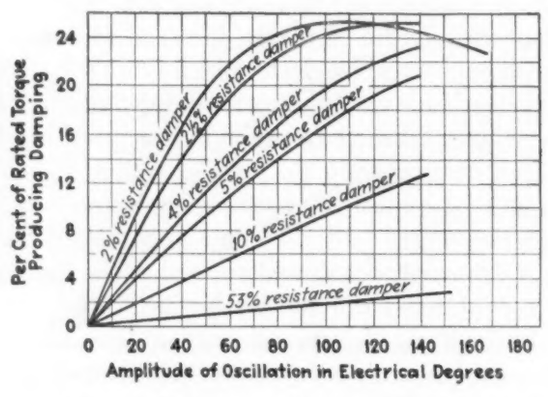


Fig. 2—Damping action of resistance in amortisseur windings

The center of generation is 170 miles from the system load center at Millbury, Mass., and 126 miles from the tie-in substation at Tewksbury, Mass. The connecting line consists of two 220-kv. circuits on separate towers. A sectionalizing substation at the midpoint of the line ties the two circuits together and in case of trouble allows half a circuit to be dropped to clear the fault.

The steady-state stability study produced a design which has a stability ratio (the ratio of the power which can be transmitted in the steady state to the total kva. capacity of the generating system) of 1.36. Figure 1a shows the values of the reactance which might be found in a system similar to the Fifteen-Mile Falls development but of conventional design. One line section is assumed to be out of service between the generating station and the sectionalizing substation. Each section of the line would have a reactance of 32 per cent; the transformers would have a reactance of 12.5 per cent; the receiver system reactance would be 17.5 per cent, and the generators would have a short-circuit ratio of unity.

In the Fifteen-Mile Falls design all the reactances under the control of the designing engineers were reduced to raise the strength of the tie between the generator and receiver systems. The transformer reactance was dropped to 9 per cent and the generator short-circuit ratio was raised to 1.50. A further reduction in the effective reactance was obtained by installing quick-response excitation on the Fifteen-Mile Falls generators and on the synchronous condenser capacity at Tewksbury (approximately 400 volts per second).

Table I—Factors Improving Steady-State Stability

	Per Cent
Gain due to low reactance transformers alone	3.2
Gain due to high short-circuit ratio alone	14.3
Gain due to quick-response excitation alone	19.4
Gain due to all factors	26.0

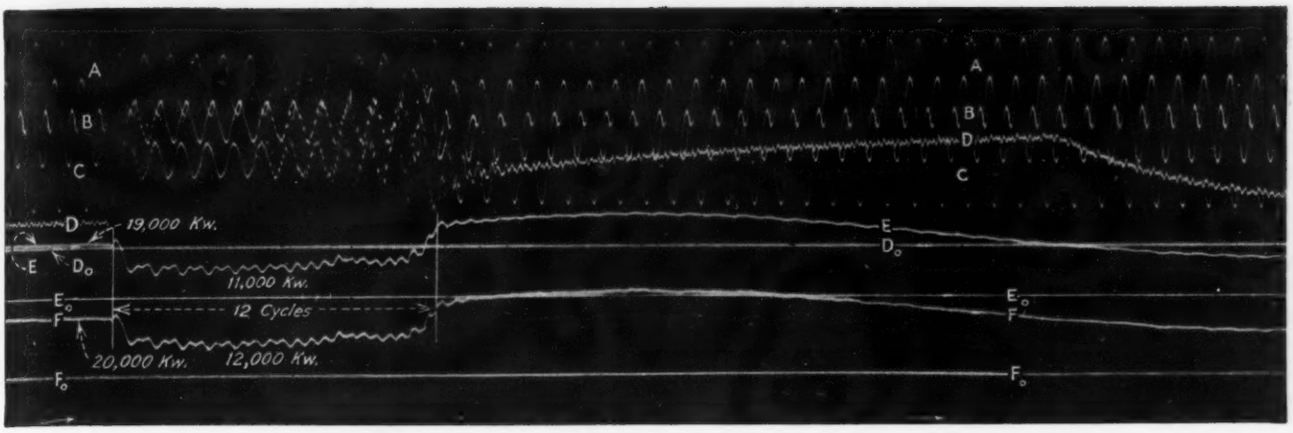


Fig. 3—Power output of two generators during a two-phase-to-ground short circuit

Showing rapidity of decay of oscillations following clearing of short

A—Generator 2, voltage phase A to B.
B—Generator 2, voltage phase B to C.
C—Generator 2, voltage phase A to C
D—Exciter 2, voltage.
E—Three-phase power, generator 3.
F—Three-phase power, generator 2.

Fig. 1b shows the values of reactance which were finally used in the design of Fifteen-Mile Falls and which raised the stability ratio from 1.08 to 1.36. The amount by which each of the contributing factors increases the stability factor above the value which might be found for a conventionally designed system is given in Table I.

A steady-state stability factor of 1.36 does not of itself indicate that the system will be adequately stable under short circuits. However, most of the factors contributing to steady-state stability also operate to improve the stability of the system under transient conditions. In the case of Fifteen-Mile Falls the net effect was a gain of about 5 per cent in the transient stability over the standard design.

Quick-response excitation used

Each generator at Fifteen-Mile Falls is provided with a direct-connected exciter, which in turn is excited from a direct-connected pilot exciter. The voltage regulators are controlled from the positive phase sequence component of generator terminal voltage for two reasons: First, the positive phase sequence component of the terminal voltage is the only one that can produce a flow of power from the generators to the receiver system to maintain synchronism; second, a voltage regulator is responsive to a single voltage, while in a three-phase machine three more or less independent voltages are to be maintained constant at its terminals. To select one of the phase voltages is to invite trouble, since under certain single-phase short-circuit conditions that voltage might actually rise and the regulator would reduce the field at a time when all the excitation available is needed.

A detailed study of the theory of amortisseur windings resulted in the selection of a generator design using double amortisseurs. The outside winding consists of "Everdur" bars having a conductivity of about 6 per cent. They are imbedded in shallow, open slots so that the high resistance is accompanied by a low reactance. The second winding is located inside the high-resistance winding and consists of bars of the same size and spacing as those in the outside winding. These bars, however, are of as low resistance as their cross-section will permit and are deeply imbedded in closed slots so that they form a winding which has a very low resistance but a high reactance.

Both of these amortisseurs act to increase the transient stability, but at different times and in different manners. When an unsymmetrical short circuit such as a single-

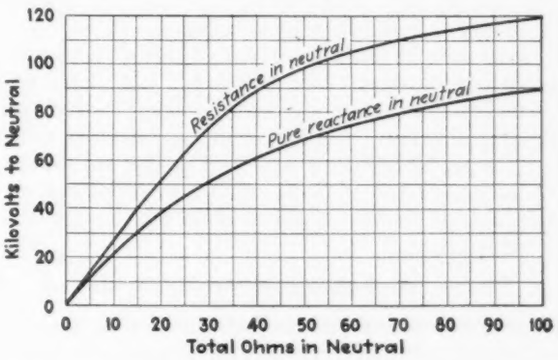


Fig. 4—Rise in voltage at transformer neutrals due to grounding impedances

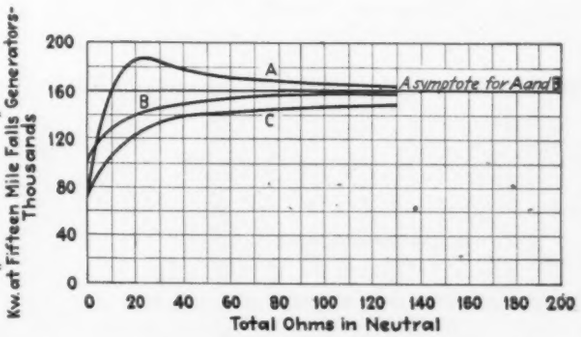


Fig. 5—Increase in power transmitted during short circuits by utilizing neutral resistance

A—Fault on Fifteen-Mile Falls high-tension bus-resistance in Fifteen-Mile Falls neutral. Curve independent of the values, 0 to 130 ohms, of reactance in neutral at Tewksbury.

B—Fault on Fifteen-Mile Falls high-tension bus-reactance in Fifteen-Mile Falls neutral. Curve independent of the values, 0 to 130 ohms, of reactance in neutral at Tewksbury.

C—Fault at Tewksbury high-tension bus-reactance in Tewksbury neutral. Curve independent of the values, 0 to 130 ohms, of reactance or resistance in neutral at Fifteen-Mile Falls.

phase or a two-phase fault to ground occurs there exists a component of flux in the air gap of the generators which rotates backward at synchronous speed with respect to the stator frame or at twice synchronous speed with respect to the rotating structure. This flux induces a voltage of twice normal frequency in two amortisseurs, but at 120 cycles the reactance of the low-resistance winding is so high that practically all the induced current flows in the high-resistance winding, which produces a high torque, tending to slow down the rotor in exactly the same manner that the external resistance cut into the rotor circuit of a wound-rotor induction motor increases its torque during starting. Since the tendency of a generator during transient instability is to overspeed and run away, this backward torque helps to keep the generators in step.

After a short circuit has been cleared, unless the torques are most fortunately balanced, the generators will have drifted to a phase angle with respect to the receiver system other than that called for under the new steady state. The proper phase angle is finally reached by a series of oscillations, and, unless some damping force is present, a condition of hunting may continue indefinitely. During hunting the field structure swings back and forth in the air gap flux and voltages are induced in the amortisseurs. These voltages are at the frequency corresponding to the slip of the rotor in the flux. This frequency is very low, probably not exceeding a few cycles per second; the amortisseur reactances are correspondingly low and the largest portion of the induced current flows in the low-resistance winding. Fig. 2 shows the relative damping action of various amortisseurs having different resistances; the low resistance damper exerts a higher torque in the same way that at low values of slip an induction motor with a low rotor resistance has a greater output than a motor similar but having a high rotor resistance.

Short-circuit oscillations rapidly suppressed

Tests were made to check the operation of the double amortisseur since the Fifteen-Mile Falls generators are the first to be so equipped. Short circuits were thrown on the system and oscillograms taken of generator power output. From these data the braking action of the high-resistance winding was computed and found to be about 20 per cent of the machine rating. The damping effect of the low-resistance winding is clearly shown in Fig. 3, by the decay of power oscillations (curves *E* and *F*) after the short circuit was cleared. The time constant of this decay for all the tests was between 1.5 and two seconds.

Experience has shown that the majority of short circuits, particularly those on transmission lines, are either single phase or two phase to ground. Under such conditions the neutral connection of the transformers carries a heavy current and anything which can be done to limit the value of this current will strengthen the tie between the generators and the load. This increase in strength is made at the expense of a voltage rise at the transformer neutrals, complete limitation of the neutral current resulting in full line to neutral voltage between the transformer neutrals and ground. Fig. 4 shows the magnitude of this voltage rise with resistance or reactance in the transformer neutrals. The economic balance for the complete development was reached with a grounding impedance of 15 ohms in the transformer neutrals at Tewksbury.

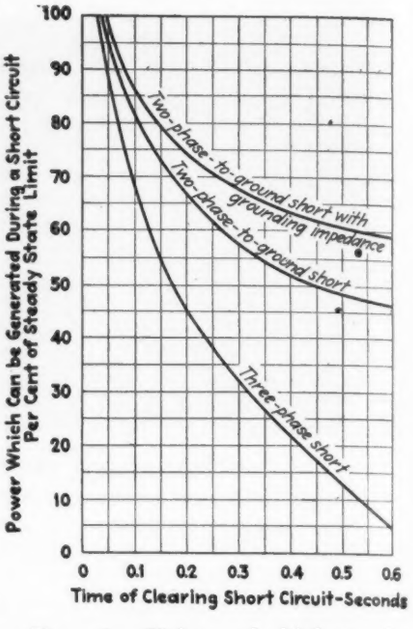


Fig. 6 — Value of high-speed switching in terms of breaker time and power transmitted during short circuits

The function of the impeder at Tewksbury is purely current limiting, thus reducing the shock of a short circuit to the receiver system. A further benefit from impendance grounding can be obtained at the sending end by installing a resistor and utilizing the braking effect of the losses in it due to the short-circuit current. Fig. 5 shows the gain in power which can be transmitted during a short circuit with various methods of neutral grounding. The maximum which can be transmitted occurs when the grounding device at the Fifteen-Mile Falls end is somewhat over 20 ohms. An allowance of 5 ohms for fault resistance reduced this value

Neutral grounding resistors at Fifteen-Mile Falls plant

Table II—Factors Improving Transient Stability with the Exception of High-Speed Switching

Based on a Double-Phase-to-Ground-Fault Cleared in 0.6 Second

	Per Cent
Low generator and transformer reactance alone	4.6
Amortisseurs alone	5.3
Grounding impedance alone	81.5
Quick-response excitation alone	16.0
All factors except high-speed switching	179.0

to the 15 ohms selected. It is not to be hoped that such elements as grounding devices and amortisseurs can be so designed as to balance exactly the loss in power output during a disturbance. However, anything which can be done to reduce the duration of a disturbance greatly improves the transient stability under every type of fault, and it is through high-speed switching that the greatest increase in transient stability is obtained.

Prior to the development by the manufacturers of high-speed relays and oil circuit breakers short circuits were commonly removed from 220-kv. systems in approximately 0.6 second. On the basis of this time for clearing a two-phase-to-ground fault Table II shows the gain in transient stability due to all factors except high-speed switching.

Value of high-speed switching

The gain due to high-speed switching is shown in Fig. 6. These curves show that with 0.6-second switching 58 per cent of the steady-state limit of power can be carried through a two-phase-to-ground fault after full benefit of grounding impedances and amortisseurs has been taken into account. If the fault is three phase only 5 per cent can be carried. The relays and oil circuit breakers on the Fifteen-Mile Falls system will clear practically every fault in not over 0.2 second. If, as the experience on other lines similar to the Fifteen-Mile Falls line indicates, the major portion of the faults are two phase to ground, then 74 per cent of the steady-state limit can be carried. The gain in this case is greater than from 58 to 74 per cent, for with 0.6-second switching the arc stretches out and may blow or whip into another conductor, transforming a fault that started as two phase to ground into a three-phase fault. So that the gain is likely to be from a value corresponding to some average between the two-phase and the three-phase condition for 0.6-second switching, say about 32 per cent, to 74 per cent of the steady-state stability limit—a gain of 130 per cent.

The high speeds of clearing faults are obtained by two types of high-speed relays controlling a very fast oil circuit breaker. One of these breakers was tested on the 220-kv. system of the Philadelphia Electric Company and it opened the short circuit in 4 cycles after its trip coil was energized. Further tests made after the breakers had been installed, with a limited short-circuit current, which was unable to develop the full effectiveness of the breaker explosion chambers, gave an average breaker time of 8.0 cycles.

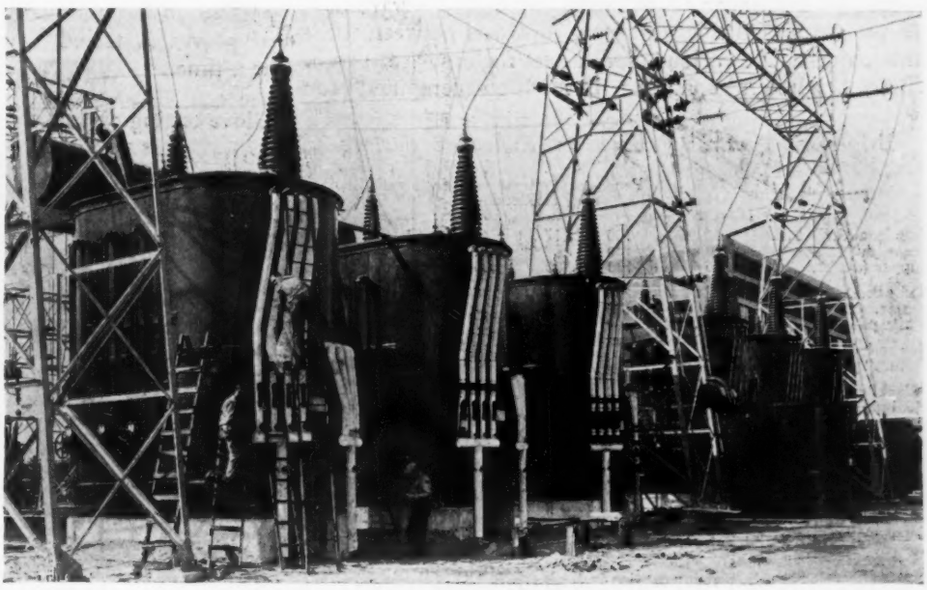
Balanced current and directional reactance relays

The first line of defense is an extremely rapid balanced current relay. It is expected that this relay will clear all faults which involve only one of the two circuits; its operating time is only 0.6 cycle, so that with a breaker operating time of 4 to 6 cycles on short circuits with high currents which might endanger stability, an estimated duration of disturbances of 0.2 second is conservative even for those faults which are close to a station bus and involve cascading of the circuit breakers.

The second line of defense is a directional reactance relay intended to operate in case of double line faults or in case of single line operation. Under these conditions there is no particular need for extremely high-speed operation; however, in case of a failure of the balanced current relays to operate, the reactance relays will act as a back-up. For this reason speed of operation is an asset. With low values of current the reactance is not particularly fast, having an operating time of approximately 6 cycles at 2 amp., but only about 2 cycles at 20 amp.

The transient analyses were first made by the step-by-step method and later checked and extended by the use of the integraph which is kept available for the solution of commercial engineering problems by the Massachusetts Institute of Technology. The curves of Fig. 6 alone, which were quickly prepared from the curves plotted by the integraph, would have taken several weeks to construct by the usual methods.

Before putting the lower development into operation a most comprehensive series of tests was made to check the operation of the various elements of the protective scheme and to verify the design studies. During these



Neutral bus arrangement and grounding impeder at Tewksbury

tests the steady-state stability was measured. Curves of power against internal angle were taken with a stroboscope for various conditions of field current and power factor and from these data an extension has been made to check the steady-state stability ratio of the complete Fifteen-Mile Falls development. This tested value is 1.45 and the difference between this value and the value of 1.36 given above is a measure of the conservatism of the assumptions on which the analytical study was made.

The transient stability was tested by throwing 22 short circuits on the transmission line with the generators carrying load. The variations in power during and after one of the short circuits are shown in Fig. 3. The small difference between the power output of the generators before the short and at the first instant after the short was cleared is indicative of the effectiveness of the braking action of the high-resistance amortisseurs and grounding devices. None of the short circuits resulted in instability, and in general the tests indicate that with the complete plant in operation there is no danger from instability except in case of a three-phase short circuit at one of the station buses.

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Brightness Contrasts Determine Visual Efficiency

By M. LUCKIESH

Director Lighting Research Laboratory
General Electric Company, Cleveland, Ohio

In everyday use the eyes are required to distinguish objects varying from the highest degrees of contrast to objects so low in contrast with their respective backgrounds that vision fluctuates, at the border, between seeing and not seeing. Although it is impractical to present a complete table of brightness contrasts encountered in seeing, a number of typical examples which have a wide application have been selected for the purpose of illustration. In the accompanying table the reflection factors of a number of the more common backgrounds are presented and the brightness contrasts between them and objects of various reflection factors are given. These brightness contrasts have been computed for objects of 0, 10, 20, 40 and 80 per cent reflection factors, respectively. These objects extend from a perfect black to a good white and therefore represent the entire practical range of this very important variable.

From these data it is possible to estimate the relative visual difficulty of various tasks of a similar nature but involving different contrasts.

Brightness Contrasts* Based on Reflection Factors

	Diffuse Reflection Factor	Per Cent Contrast of Objects with Backgrounds† (Reflection Factor of Objects)				
		0	0.1	0.2	0.4	0.8
Cast iron (dull)	0.12	100	17	40	70	85
Brass (dull)	0.30	100	67	33	25	62
Copper (dull)	0.25	100	60	20	38	69
Red oak	0.32	100	69	38	20	60
Poplar	0.47	100	79	57	15	41
White pine	0.61	100	84	67	34	24
Newsprint	0.60	100	83	67	33	25
"White" paper	0.80	100	88	75	50	0
"Black" paint	0.04	100	60	80	90	95
Medium gray	0.50	100	80	60	20	38
Dark gray	0.10	100	0	50	75	88
"White" paint	0.80	100	88	75	50	0
Black velvet	0.005	100	95	98	99	99.5
Black cloth	0.02	100	80	90	95	98
White linen	0.76	100	87	74	47	5

* Brightness contrast is defined as the ratio of brightness difference (between object and background) to the brightness of the background and designated as per cent contrast; or Per Cent Contrast = 100 (*Background Brightness—Object Brightness*) ÷ Background Brightness.

† The surface with the higher reflection factor is considered as the background.

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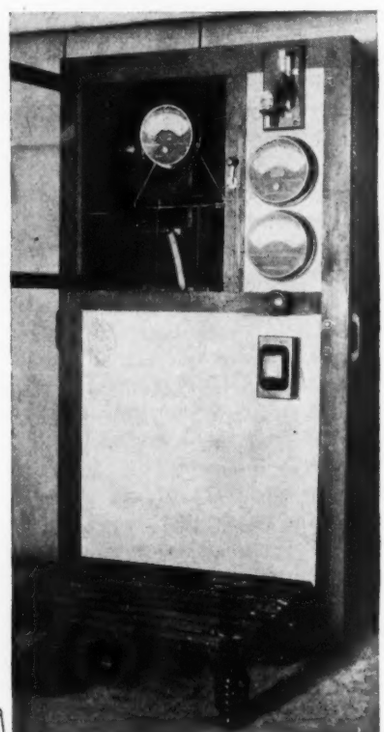
Interlocked Switches Safeguard Rubber Glove Test

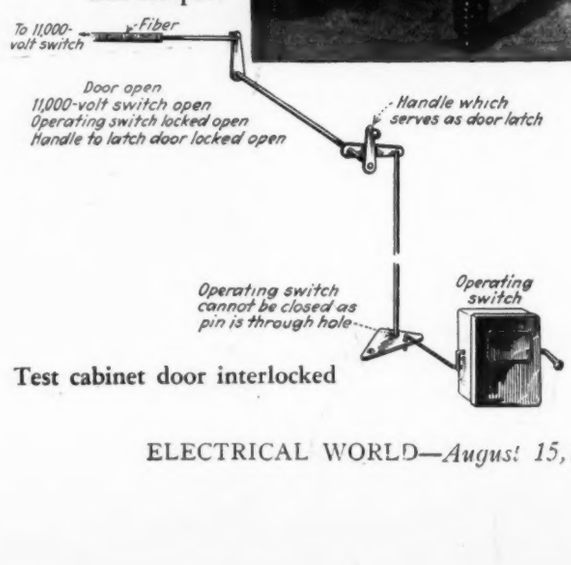
By R. G. KENNISON

Central Maine Power Company, Augusta, Me.

In testing rubber gloves the Central Maine Power Company developed a safety cabinet to inclose all live parts as well as the gloves and tank, and access to the interior was provided by a glass door held closed by a latch. The throwing of this latch to keep the door shut automatically closes a disconnecting switch in the 11-kv. test circuit. The latch cannot be thrown when the door is open, and, on the other hand, unless the latch is thrown to lock the door when it is closed a 110-volt primary switch completing the test transformer supply circuit cannot be closed. An insulated platform is also provided for the operator. The cabinet, which is 6 ft. 11 in. high, 3 ft. 8 in. wide and 2 ft. 3 in. deep, was built of asbestos board oil switch panels. One pair of gloves is tested at a time.



Glove testing cabinet is portable and compact


To 11,000-volt switch
Fiber
Door open
11,000-volt switch open
Operating switch locked open
Handle to latch door locked open
Handle which serves as door latch
Operating switch cannot be closed as pin is through hole
Operating switch

Test cabinet door interlocked

Covering Up Costs in Municipal Utility Operations

By ARTHUR HUNTINGTON
Iowa Railway & Light Corporation, Cedar Rapids, Iowa

Expense of interest, depreciation, tax losses and administration are easily buried.

Service, the politicians' abhorrence.

"IF THE items of interest and depreciation are forced into the operating statements of municipally owned public utilities the cause is lost." This candid statement was made at the last meeting of the League of Municipalities of Iowa. Thus municipal ownership advocates believe that a municipal ownership operation must withhold certain facts from public knowledge if it is to have the appearance of success.

Experience has shown that if a politically operated business is to succeed it must have about a two-to-one advantage over one guided and directed by private initiative. In other words, the municipally directed utility must be able to hide approximately 50 per cent of those costs which the private operator must care for from earnings.

Let us examine the costs which enter into the operation of utilities and inquire into the tricks of the trade which politicians must use if they are to hoodwink the public into accepting their operating statements. Briefly, costs are made up of the following items:

1. Capital costs or interest on the money invested.
2. Operating expenses or the cost of running the property. (This item should include repairs or upkeep on the property.)
3. The replacement of the property when it becomes obsolete or worn out.
4. Administration.

How does the politician operate to escape a full accounting? How does he proceed to gain the two-to-one advantage he must have? He cannot escape operating expense, for therein his inefficiencies occur. He must gain his advantage some way by manipulating the three others. He must have one of three things—free capital, a long-lived property or property which is cheaply maintained. He may charge the administrative expense to the taxpayer directly. He may have some form of subsidy. His property may become obsolete; usually he takes a portion of his advantage from each.

The political operator can do a lot of juggling with his property operating accounts. There is another factor which the politician has carefully nursed. He must not be called upon to account for the money invested. He is not usually interested in any public operating enterprise unless he can count the property as a part of the city's permanent assets. It is quite embarrassing to have to account for capital oftener than once, or at most twice, during the life of each business generation unless it can be shown that the natural growth of the business calls for more property, thus affording an opportunity to replace obsolete and worn-out equipment at the taxpayers' expense under the guise of new property.

Above all, he must not be called upon to render a return on the public's money, and the property, no matter what its physical condition is, must be accepted as worth 100 per cent of its purchase value at all times; he must have that contribution from the public before he can hope to compete, and as it is the public's fund he cannot be asked to pay taxes, either within the territory served by his plant or any other territory. Handling public property with public funds he is a public official, and as such he can collect the administration costs from the public treasury.

What political ownership must have

Again, how is the political operator going to meet this two-to-one handicap, whereby he can offset his inefficient operation and pay the expense of having two men (voters) doing the work of one man who has the spur of private initiative?

He must get that advantage from:

I. Free capital, or nearly free. As an electric light property has from $5 to $6 invested for each dollar of gross income, he must have from 25 to 30 cents left out of each dollar taken in, or 25 to 30 per cent of his gross income with which to pay interest on the bonds which created the plant.

II. He attempts operation only where the life of the property is long. The life of electric light and power property is about fifteen to twenty years, so that there must be an allowance of at least 4 per cent of the value of the property, with interest compounded annually, per year set aside to replace the property when worn out. This is 20 to 24 cents out of each dollar of gross annual income.

III. The business must be of such a type that there

will not be calls for an accounting of capital oftener than once, or at most twice, during the business life of one generation.

IV. The business must be tax exempt. Electric utilities pay a total of about 6 to 10 cents of each dollar of their gross income in some kind of a tax.

The sum total of items I, II and IV is 51 cents under the best conditions, and may be as much as 64 cents out of each dollar of gross annual income under more ordinary conditions. It is in these three items that the greater part of the 50 per cent advantage comes. Under careful political maneuvering it can be, and often is, 51 to 64 per cent.

V. In addition to this large subsidy there are usually such indirect subsidies as:

(a) Management paid out of the public treasury.

(b) Favorable contracts from other publicly operated industries which can be used as an excuse for levying taxes for the support of the whole operation. It is not uncommon to see a municipally operated electric property favored with a contract from the water department which fills up a large hole in the electric plant's operation costs.

VI. Above all, he must make the taxpayers responsible for the capital which creates the enterprise, principal and interest, both of which must be cared for by levying a tax. Few people ever stop to think that a city bond issue is a first mortgage on each piece of privately owned property in the city. Many people cheerfully vote a heavy mortgage on their property to procure funds to start in business men whom they would not back for one cent in private business.

All told, so long as the political operator can disregard 51 to 64 per cent of those costs which the privately owned utilities must meet from their income he can compete. When he is required to make an accounting of such items he must convince the voters that socialism is preferable to private business.

Some municipal plants do make small profits during some years, but few of them ever make a profit in any year equal to the subsidies above referred to. Nearly always the promised profits, even with the approximately 50 per cent subsidy from the taxpayers, fail to materialize.

Buried, but not dead costs

The city of Muscatine, Iowa, was promised by its politicians $120,000 profit from its municipal electric plant from March 21, 1929, to February 23, 1930, as a return from the $959,187.51 which the city gave to them for their business venture, according to the Muscatine *Journal*, July 29, 1929. No figures have yet been made available for this period. From June 30, 1924, to December 31, 1928, the following is a statement as given out to the public by the city administration:

Gross return	$522,296.26
Gross expense	317,720.37
Net return	$204,569.89

This figure of $204,569.89 is called net by the city fathers. In presenting this statement to the citizens of Muscatine in January, 1929, Mayor H. G. Thompson said: "This report contains everything any one would wish to know about the local utilities."

The statement does not mention the following items: Interest on the investment, $161,434.91; depreciation of the property based on twenty-year life for electric property and 33 1/3 years for buildings, $160,664.90; loss of taxes, $54,173.10; total unaccounted for, $376,272.91.

A true and complete statement would read: Gross income, $522,290.26; operation expenses accounted for by politicians, $317,720.37; cost not accounted for, $376,272.91; total cost of service, $693,993.28; net loss, $171,703.02.

Note that of the $693,993.28 of gross expense the politicians accounted for $317,720.37, or about 45.6 per cent of the total cost, and that they "buried" $376,272.91, or 54.4 per cent. In addition to this the tax rate increased from 27.5 mills for 1924-25 to 35.5 mills for 1928-29. The time of city officials and many other city expenses which are partly chargeable to the electric light venture are not mentioned in this report and will always remain unknown.

Take a statement of the city of Los Angeles, Calif., which has been given national publicity.

The final line of the city's report shows: Net profit for year ended June 30, 1927, $3,258,488.43.

Compare this statement with one worked out by a public accountant covering the same property and the same period. The last three lines of the accountant's statement shows:

Returns above operating costs	$3,258,488.43
Cost of money and loss of taxes	6,417,105.05
Deficit paid by taxpayers	$3,158,616.62

Which is correct?

Generally speaking, the socialist is interested in controlling the telegraph and telephone lines, but on account of service requirements the politician has little interest in these industries. Telephone service hinges on seconds required to complete calls; politicians abhor such service requirements. In addition to those strict service requirements, telephone equipment becomes obsolete before it is worn out.

While we are talking about equipment and service, allow me to suggest that had it not been for private initiative we would be without any of the public utilities as we now know them. When municipal and state control of an industry begins, progress stops.

In the electric industry there are three distinct types of plant, each with a different political and socialistic appeal:

1. The electric property which must depend upon the small steam plant for its power. In this type of plant it requires a pretty fair operator to hide 50 per cent of his costs. It is this type of utility which usually sells out to the private operator at the end of ten to fifteen years of relatively poor, high cost service.

2. The electric property which derives its power from oil engines of the best design, or, if large enough, uses steam turbines. Both of these engines are expensive to install and cheap to operate, and as both interest and depreciation are buried it is possible to make a fine operating statement. Generally speaking, with this type of plant, and fair load conditions, it is possible to leave 55 to 60 per cent of the costs unmentioned.

3. Where there is an available hydro power it is possible to hide as much as 80 per cent of the total

costs. When all of the costs are considered, water power is not cheap, but there is a prejudice in the average man's mind that it is very much cheaper than steam power. Steam plants in Buffalo are able to compete with Niagara Falls, the world's greatest water power, only 20 miles away. Usually the best water-power sites are far from the place where the power is to be used and must be provided with a steam auxiliary, thus making hydro power expensive. These are, however, minor factors in the hydro power situation. The fact that 80 per cent of the costs can be buried makes the political operators' and the socialists' eyes glow with fervor for the people's rights.

The lure of tax-exempt securities

There is another factor which is of vital importance in the controversy between the socialist, or political, and the business operator, namely, the purchaser of tax-exempt securities. Due to the length of time which municipal bonds run, the fact that they are tax exempt, with interest and principal collected at public expense, and are guaranteed by a pledge which comes ahead of all other types of mortgages, they are very attractive securities for investors to hold. The avarice of the purchaser of tax-exempt securities is a large factor in municipal ownership, and thoughtlessly he is casting his lot with both the socialist and the politician.

The late Senator J. B. Foraker of Ohio, in commenting on the purchase of the local water plant by the city of Cincinnati, said: "When it is remembered that this property was sold to the city and not purchased by it, one must admire the business sagacity of a group of men who can exchange an old, broken-down water plant for a first mortgage on the whole city of Cincinnati. The most remarkable thing about the whole transaction is that these men have succeeded in inducing a large majority of our citizens to mortgage their homes in order that funds may be provided to be used in setting politicians up in a business the nature of which they know nothing."

In conclusion, it can be said that municipal ownership was not created in the interest of the people or the taxpayer. It is the child of the socialists and the politicians, and survives by virtue of the selfishness of investors and the ignorance of the people as to the truth.

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High-Pressure Manhole Washing Saves Expense of Opening Drains

By C. B. SHARP
*Underground Lines Department, Detroit Edison Company**

Forty plugged manhole drains was the average per month reported on the underground system of the Detroit Edison Company when manholes were being cleaned by hand. The number has been reduced to 28 through the use of water at 120 lb. pressure supplied from a tank truck. Also the cleaning is done better, quicker and with fewer men.

The hand method required seven gangs of two men each to keep clean the 9,400 manholes in an area of 140 square miles. Each gang would average about 40 jobs per day at a cost of 24 cents per manhole. The operation of the tank truck for the first two months of this year is summarized in the accompanying table.

The costs given in the table do not include gasoline for either month nor water used in February. These would

Based on report to underground systems committee, Engineering Section, Great Lakes Division, N.E.L.A.

High-Pressure Manhole Cleaning

	January	February
Total number of manholes cleaned	1,832	1,812
Total number of tanks of water used	41	46
Total number of drains opened	25	69
Total number of days worked	21	20
Average manholes cleaned per day	87.2	90.6
Total number of gallons of water used	30,750	34,500
Average gallons per manhole	16.8	18.97
Number of miles traveled	47	237
Number of gallons gasoline	266	326
Number of gallons gasoline per manhole	0.14	0.18
Approximate cost per manhole, cents	22.3	21.4

Mobile unit for manhole cleaning

The truck is manned by a crew of three men, a driver and two laborers. The driver stops the truck just clear of the manhole. He then engages the pump in gear and brings it up to speed, during which time one of the men on the back of the truck has pulled the manhole cover, the second man, with hip boots, raincoat and hat, takes the hose off the rack and descends into the hole for the washout.

add about 3 cents, making the tank truck costs slightly higher than the 24 cents quoted for hand cleaning. But the 24 cents is a year-round average, while the costs in the table are for the two worst months of the year. It is reasonable to anticipate that the yearly average cost of tank truck operation will be much lower than the figures given. Further, these costs recognize neither the savings of reduction in the number of plugged drains nor the better quality of work done which will further reduce the cost of following cleanings.

A Dodge 2-ton model F-40E truck chassis was purchased, having a standard cab and 150-in. wheelbase. Mounted on this chassis is an elliptical tank 9 ft. 6 in. long, having a capacity of 750 gal. of water, with two splash plates to break up the body of water. One of the American Steam Pump Company's model B-2A rotary pumps is mounted on the running board on the right side of the tank and chain driven from a Brown & Lipe 438 power take-off that is bolted to the transmission housing and operated by a special gear shift lever and disengaged from the engine by the truck clutch. The gear ratio is five to seven. This pump has a 3-in. intake, a $2\frac{1}{2}$-in. discharge and will give a pressure of 120 lb. per square inch at the nozzle. The capacity of the pump is 340 g.p.m. for a lift of 20 ft. when the pump is turning up 1,400 r.p.m. The pump is below the tank and therefore self-priming.

The pump is used for pumping water, either from the manhole or into the manhole for flushing purposes, all controlled by the proper operation of the valves at the rear of the truck and at the pump. The piping system is arranged with a quick-operating valve on the end of the hose; it is impossible to cause water hammer in the equipment because there is a 1-in. line that by-passes the valves and discharges into the tank. This by-pass line also tends to keep the water from freezing in the lines in cold weather because the pump can be left in operation while driving, thus keeping the water agitated by continuous circulation.

The total weight of the equipment, without water, is around 8,460 lb. and its cost approximately $2,722 complete. A large rectangular box is fastened to the side of the truck, in which the tools, manhole hook, rubber goods, etc., are carried.

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Meter Test Timing by Photo Relay

One-second impulses for precision timing in calibration of rotating standards are obtained by the Public Service Company of Colorado through the medium of a photo-electric tube in conjunction with a master clock. It was designed and built by the electric meter department of the company.

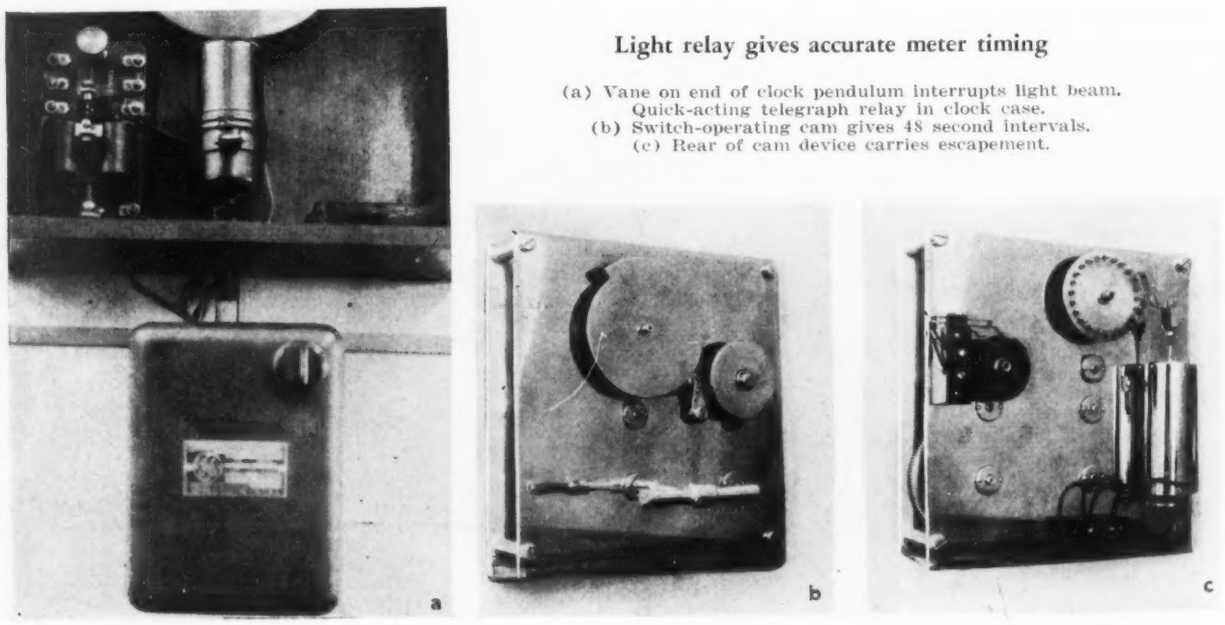
The device consists of a spring-wound set of gears operating a switch which alternately opens and closes a potential circuit every 48 seconds. A solenoid, which receives impulses each second from a master clock, operates an escapement mechanism and releases a switch-operating cam 1/48 of a revolution each second. The switch is operated once for each revolution of the operating cam.

The one-second impulses are obtained through the use of a General Electric photo-electric relay. The heavy relay ordinarily used in this equipment has been replaced by a delicate quick-acting telegraph relay. A vane is used on the end of the pendulum to interrupt the light beam which operates the photo-electric tube.

This outfit at once gives a frictionless contact device and the very accurate time interval so essential to the correct calibration of rotating standards. It is made of heavy construction so that there will be very little wear on the moving parts. The gears are of steel and bronze, gear shafts are of steel and run in heavy bronze bearing mounted in $\frac{1}{8}$-in. brass side plates and the escapement and escapement pins are made of tool steel, tempered to the proper hardness.

Light relay gives accurate meter timing

(a) Vane on end of clock pendulum interrupts light beam. Quick-acting telegraph relay in clock case.
(b) Switch-operating cam gives 48 second intervals.
(c) Rear of cam device carries escapement.



What's Patentable in Electrical Engineering

By CHARLES W. RIVISE
Patent Attorney, Philadelphia

Claims are the heart of the patent. Some discoveries are unpatentable. Much of patent law is founded on negative rules.

A PATENT is a promise by the government to protect the inventor in his exclusive enjoyment of the invention for a term of years provided he makes such a full and exact disclosure of his invention that the public can practice it after the expiration of the inventor's monopoly. The patent statutes do not compel an inventor to apply for and obtain a patent. If his discovery is of such a nature that he feels that it is safe from discovery, either by observation of his invention or by independent investigation and experimentation, he would have a much more endurable monopoly by refusing to take advantage of the patent laws. It is only when he fears discovery and resultant injury from the exercise by others of his invention that he need protect it by a patent. However, the inventor who elects to protect his invention by secrecy, rather than by seeking patent protection, always runs the risk of losing his right to a patent when his secret leaks out.

Disclosure must be adequate

In order to take advantage of the protection afforded by the patent statutes, the inventor is required to make a written description of his invention or discovery and of the manner and process of making, constructing and using the same in such full, clear, concise and exact terms as to enable any person skilled in the art or science to which the invention or discovery appertains to make, construct, compound and use the same. Any disclosure that falls short of this requirement will result either in the refusal of a patent or in the grant of an invalid patent.

It must be emphasized, however, that the inventor is not bound to state all the advantages and functions of his invention or all the uses to which it may be put. Neither is he required to state the scientific principles or theory underlying his invention or the causes which produce the desirable result. And if he does state what he believes to be the principles governing his discovery, it is wholly immaterial to the validity of the patent whether or not the statement is correct, so long as he has so set forth the thing to be done that it can be reproduced by one skilled in the art.

Thus in the case of Marconi Wireless Company vs. DeForest Radio Company (243 Fed. Rep., 560), Patent 803,684 to Fleming on a wireless detector was sustained, though the defendant earnestly contended that the invention was predicated on an erroneous theory of rectification.

The law further requires the inventor to point out and distinctly claim the part, improvement or combination which he claims to be his invention or discovery. This he must do in one or more short statements at the end of the description. Each one of these statements is termed a claim.

The claims are the vital part of the patent and define the scope of the patent. Great skill is required in drafting them. Usually the patent examiner does not agree with the inventor that the presented claims represent his contribution to the art. In such cases the inventor may amend the rejected claims or try to persuade the examiner to his own way of thinking. When the inventor and the examiner finally agree, the patent is granted with the claims agreed upon. If they cannot agree, the inventor may appeal to a higher tribunal in the Patent Office and then to the courts. But if the inventor acquiesces in the rejection of a claim and the patent is granted with a narrower claim, he is forever estopped from contending that he was entitled to the broader claim.

Each claim in a patent is considered a separate and independent invention. One may be valid, all the rest invalid. But the claim that is good remains good and is unaffected by the presence of those that are bad. Likewise, one claim may be infringed and the others not. In other words, the patent does not stand or fall as a unity—each claim is in effect a separate patent.

Patentable subject matter

No matter how ingenious or epoch-making an invention or discovery may be, no valid patent can be secured unless the subject matter thereof can be expressed in one or more of the following ways: (1) An art; (2) a machine; (3) a manufacture; (4) a composition of matter; (5) an improvement on an already existing art; machine, manufacture or composition of matter; (6) a design for an article of manufacture; (7) a newly created plant asexually reproduced by its discoverer.

The term "art" is commonly considered synonymous with the word "process" and may be best defined as "an operation performed by rule to produce a desired result by means not solely mechanical."

The usual test to determine whether a so-called method is a true process or the mere function or mode of operation of a machine is whether the process can be carried out by more than one form of machine or tool. If it can, it is a true process, otherwise, not.

If the process can be carried out by means of a newly invented machine, both the method and the machine may be patented, either in the same or different patents.

Electrical systems are "machines"

A machine is generally defined as "an instrument composed of one or more mechanical powers and capable, when set in motion, of producing by its own operation certain predetermined effects."

The definition is somewhat deficient in that it does not specifically cover electrical systems having no movable mechanical parts. But, under the patent law, a wireless receiving or broadcasting set is as much a machine as a steam engine or an electric fan.

The difference between a machine and an article of manufacture is that a machine has a law of operation inherent within itself, while an article of manufacture has no inherent law, but depends entirely upon external forces. The difference between an article of manufacture and a composition of matter is that in a composition the patentable quality resides in the combination of ingredients, while the patentability of an article depends upon the inherent characteristics of the article itself. An article may be composed in whole or part of a composition of matter, which in itself may be novel and form the subject mater of a patent.

Improvements, designs and unpatentable discoveries

An improvement is an addition to or an alteration in some already existing art, machine, manufacture or composition. It need not be better in all respects than the thing upon which it purports to be an improvement.

Principles and forces of nature fall outside the above classification and hence are unpatentable. However, it must be emphasized that though neither the cause nor its effect is patentable by itself, the means by which the cause is applied to produce the effect is patentable. Likewise, a new property discovered in matter, when practically applied in the making of a new manufacture or composition, may be the basis of a valid patent. In other words, the principle of nature itself is not patentable, but its utilization by means of an art, machine, manufacture or composition of matter, when properly expressed in one of these forms, is patentable.

Simplicity does not imply lack of invention. As a matter of fact and of law, the highest trait of genius is to obtain simplicity. Obviousness, on the other hand, may be proof of non-invention except in cases where the change in the prior device appears obvious only after it has been made.

The courts have decided individual cases on their own merits by means of a process of exclusion. As a result of the many adjudicated cases in which this process has been utilized, there has grown up a set of negative rules, which are to be applied in given situations to determine whether certain variations in old devices and processes do or do not arise to the dignity of invention.

Negative rules for patent law

The first of these rules is that it is not invention to produce a device or process which any skillful mechanic or chemist could produce whenever required. The test is whether an ordinary person skilled in that particular art would spontaneously make the change represented by the invention. If he would do so there is no patentability.

The second rule is that a mere carrying forward of the original thought, a change only in form, proportions or degree, doing the same thing in the same way by substantially the same means, with better results, does not constitute patentable invention:

> In the case of Benjamin Electric Company vs. Northwestern Electric Company (251 Fed. Rep., 288), an electric attachment plug designated as "midget" or "dwarf" was held unpatentable because of its small size, though its compact size made it more convenient than large plugs.

Exceptions to the rule are made, however, when the result is disproportionate or unexpected:

> Thus, an exception was made in the case of Edison Electric Light Company vs. U. S. Electric Lighting Company (52 Fed. Rep., 300), involving Edison's carbon filament patent. It appeared that Edison's carbon filament differed from the carbon burners of Sawyer and Man in being $\frac{1}{64}$ in. in diameter instead of $\frac{1}{32}$. This reduction in diameter by 2 was held to be more than a change in degree, since it increased the resistance of the burner by 4, decreased the radiating surface by 2 and thus increased by 8 its ratio of resistance to radiating surface.

The third negative rule is that it does not involve invention to substitute superior for inferior materials in making one or more parts of a thing, unless the substitution involves a new mode of construction, or develops new uses and properties of the article not obvious from the change, or where superiority of the substituted article is shown to consist not only in greater cheapness and durability, but also in more efficient action.

The fourth rule is that it does not constitute patentable invention to duplicate one or more parts of a device:

> Thus, in the case of Electrical Accumulator Company vs. Julien (38 Fed. Rep., 117) it was held unpatentable to add additional cells to increase the power of a battery. For the addition produces merely a duplication of the old result. An exception to this rule is made when the duplication of part modifies the old result in an entirely unexpected manner or produces a new result.

Omission of elements and portability

The fifth rule is that it is not invention to omit one or more parts of an existing thing, unless the omission causes a new mode of operation of the parts retained, or results in a substantial simplification of construction or rearrangement of the remaining elements whereby the same or a better result is obtained by a less number of parts.

The sixth rule is that it does not constitute patentable invention to make an old device portable. The advantage and convenience arising from making a device portable are usually so obvious that their perception and appreciation cannot be held to involve an exercise of inventive faculty.

The seventh rule is that no invention is involved in substituting equivalents in an old device or thing. An equivalent is usually defined as an element that performs the same function, in substantially the same way, to pro-

duce substantially the same result as that produced by the element replaced.

The eighth rule is that no invention is involved in merely changing the relative location of parts of an old device. If the change in location is not merely arbitrary, but is accompanied by some unexpected or unobvious result, the courts will uphold the patent.

Rule 9 is that it is not patentable to make an element adjustable, if no unexpected new result is produced by the change. Thus, it has been held not to constitute invention to make a tool adjustable in four directions instead of two.

Making parts integral or separate

The tenth rule is that there is no invention in making two parts integral that had previously been separate, and *vice versa*, unless the new integral part or the separate parts perform some new or additional function that is unobvious from the change. It has been held that an increase in strength is not such an additional function as to create an exception:

> Thus, in the case of Fones vs. American Specialty Company (38 Fed. Rep., 1639), it was held to lack invention to make the insulating base of a switch in two parts and to make the base bottom which carries the spring contacts detachable from the bottom portion.

The eleventh rule is that the application of an old device or process to a similar or analogous subject, with no material change in the manner of applying it, is not patentable even if the new form or result has never before been contemplated.

This rule, often referred to as the rule of double use, is tied up with the question of analogous art. A man is expected to know of a solution in his own and analogous arts, but not in remote arts. Hence, it may involve invention of a high degree to take over a device from an entirely unrelated art and apply it to produce a different result, even if no material change is made in the construction.

Illustrations of cases in which the adaptations were held to be mere double uses are as follows:

1. A condenser for a radio receiving set was held anticipated by a magneto condenser in Dubilier vs. Aerovox (37 Fed. Rep. [2d], 657).
2. Soldering and welding were held to be analogous arts in the case of Thomas Spot Welder Company vs. Fort Motor Company (265 U.S., 445), invalidating patent 1,046,065 to Harmatta for spot welding.
3. Applying an automatic shifting device that had been previously used with a washing machine to a rawhide fulling device. The shifting device operated in exactly the same manner in both cases, Royer vs. Roth (10 Supreme Court Reporter, 58).

But in some cases the new adaptation was held to be more than a double or analogous use and hence patentable. Thus, in the case of Western Electric Company vs. La Rue (139 U. S., 601), it was held to constitute invention to adapt a torsional spring previously used in clocks for use in a telegraph instrument.

In many cases it has been held that the necessity of considerable change in the old device to adapt it for its new purpose is evidence of invention.

The twelfth and last negative rule is that aggregation or lack of combination is not patentable. Restated in non-technical language, the component parts or elements of a device or a process must co-act with each in such a manner as to produce a unitary result which is not merely the aggregative effects of the individual elements.

When operations or devices are brought together and united, one or the other of two results must follow. Either each element remains unchanged in function or effect, or each one performs additional functions and produces additional effects due to their action upon each other or their joint action upon the common object. The former union is an aggregation or a mere collocation of elements and is not patentable.

If several elements are brought together so that additional functions are performed and additional effects are produced, the union is a true patentable combination. In such a combination the final result is unitary and due to the joint co-action of all the elements. It is not, however, necessary that all the elements operate simultaneously so long as every one of them contributes to the unitary result. They may operate successively. Nor is it necessary that all the elements co-act or co-operate with each other all the time, as long as they do so part of the time to produce a new and useful result or an old result in an improved and modified manner. In any event, the result must be more than that of the separate elements, and the combination of elements in correlation must produce a different force, or effect, or result, from the sum of that which is produced by their separate parts.

A new and patentable combination may be produced by bringing together a number of old elements, or by rearranging the elements of an old combination. In fact, most of the inventions for which patents have been granted cover just such types of combinations. As illustrations may be mentioned electrical circuits and systems. In each instance the invention consisted in bringing the old elements together and arranging them to produce a new and unitary result.

It often happens that the elements themselves are new and patentable. In such case patent protection may be secured on both the combination and on each of the new elements. However, it must be emphasized that if a new element is introduced into an old combination, a patent cannot be secured for the combination unless the new element co-acts with the remaining elements in a different manner than did the replaced element to produce a modified or different effect. In other words, improving merely one element of a combination does not ordinarily create a new combination in a patentable sense. Thus, if an inventor improved a switch forming part of an electrical system, he could secure a patent on the new switch, but not on the system containing the new switch.

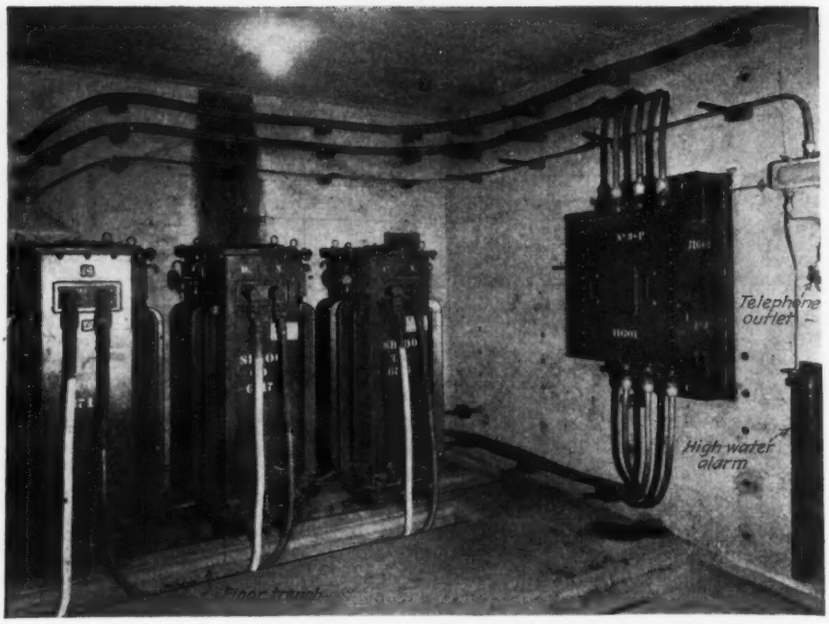
Summary

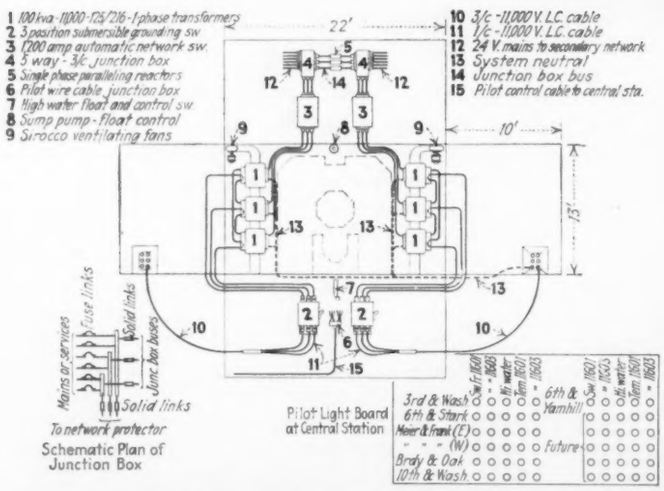
It may be laid down as a general rule that an invention or discovery is patentable if it relates to patentable subject matter and produces an unobvious or unexpected result or an old result in an improved and unobvious manner.

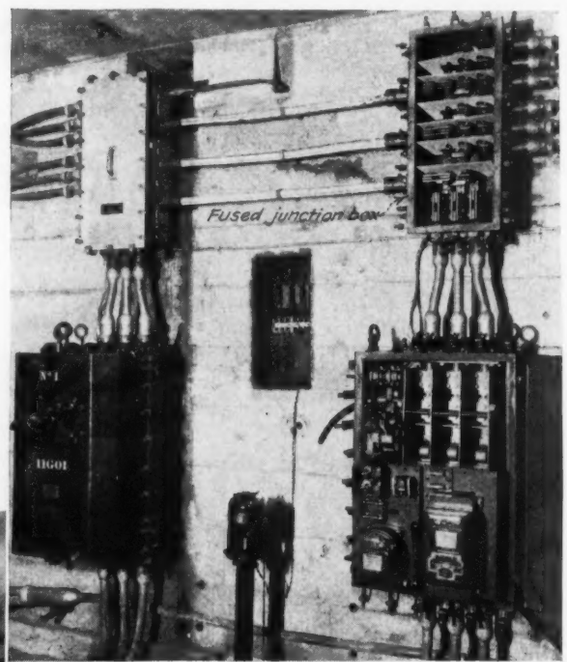
If there is any doubt in the mind of the court that invention exists in a particular case, the doubt will usually be resolved in favor of the patentee. This is especially so if he can show that his invention satisfied a long-felt need and solved a problem that existed for years in spite of all that prior workers in the art claimed to have accomplished. It often helps also to show that the teachings of the patent were regarded with skepticism when first disclosed to workers in the art.

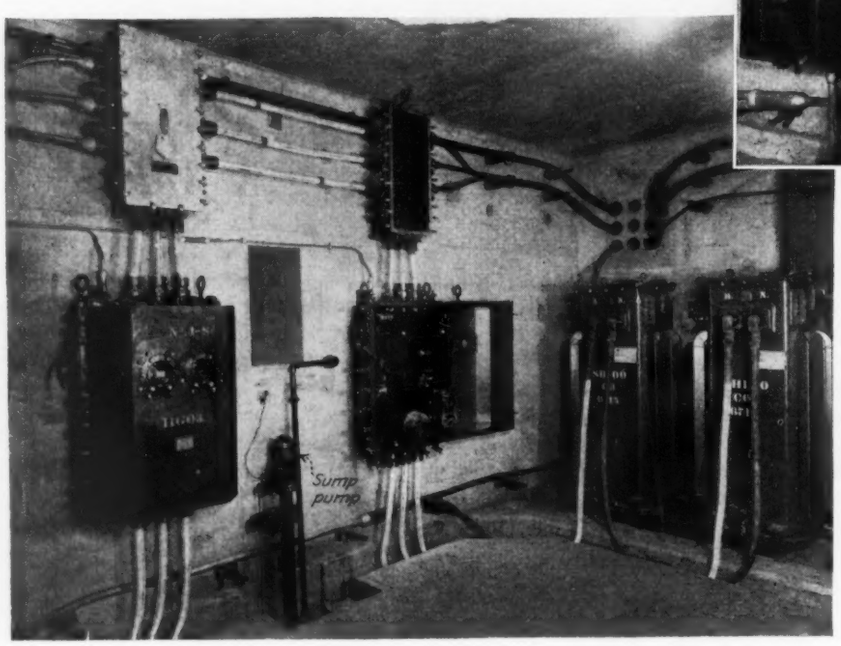
High Standards for Underground Network

Unusually high standards of construction with refinements making for flexibility and economy of operation have been set by the Northwestern Electric Company in the design of an alternating-current underground network in Portland, Ore.




1 100 kva - 11000-125/216-1 phase transformers
2 3 position submersible grounding sw.
3 1200 amp automatic network sw.
4 5 way - 3/c junction box
5 Single phase paralleling reactors
6 Pilot wire cable junction box
7 High water float and control sw.
8 Sump pump - Float control
9 Sirocco ventilating fans
10 3/c - 11,000 V. L.C. cable
11 1/c - 11,000 V. L.C. cable
12 24 V. mains to secondary network
13 System neutral
14 Junction box bus
15 Pilot control cable to central sta.
22'
10'
13'
Fuse links
Solid links
Mains or services
Junc. box buses
Solid links
To network protector
Schematic Plan of Junction Box
Pilot Light Board at Central Station
3rd & Wash
6th & Stark
Meier & Frank (E)
" " (W)
Birdy & Oak
10th & Wash
6th & Yamhill
Future





Features are:

11-kv. duplicate radial primary.

Pilot system between vaults and station indicating position of network protectors, transformer temperature and giving high water alarm.

Telephone outlet in each vault.

Automatic mechanical ventilation.

Sump pumps.

Floor trenches for secondary cables.

Fused junction boxes.

Duplicate transformer banks in each vault networked within the vault.

Bare neutral with thin lead sheath.

Ample cubical contents for vault rating.

St. Lawrence Power Study Reveals Distribution Costs

By S. BURTON HEATH
Secretary late St. Lawrence Power Development Commission

THE reasons why electricity generated at a cost of a few mills per kilowatt-hour is sold for several cents, creating the much-discussed "spread" between generating cost and selling price, may be analyzed to excellent advantage with the aid of material contained in the marketing section of the recent report of the St. Lawrence Power Development Commission. The St. Lawrence commission's marketing report was not designed primarily to explain this spread. It was intended to aid the commission in deciding whether 5,300,000,000 kw.-hr. from the Long Sault rapids could be marketed beneficially in New York State, and if so, where and how. Of fundamental significance in such a study are the cost of placing St. Lawrence current in various load centers, under the multifarious possible conditions, and the present and future costs of the other sources of electricity with which that from the St. Lawrence must compete. In determining these things Col. John P. Hogan, of Parsons, Klapp, Brinckerhoff & Douglas, and Dr. John Bauer, the commission's marketing experts, went to the roots of many questions of electricity cost and brought together in a public document a great deal of pertinent information.

Load factor a determining element of cost

The conclusions arising from this study, of course, merely confirm what practical utility operators have long known—that the spread between generating cost and average total cost per kilowatt-hour, at any given load factor, depends upon transmission, distribution and general expenses intervening between generation and use, while the spread between small-use household rates and large-use industrial rates depends primarily upon the low load factor and consequent capital charges upon idle facilities in the case of the small user, plus the much greater proportionate administrative costs of distribution in insignificant quantities.

This was demonstrated, however, by both ideal and practical studies, the former based upon an imaginary state system for generating, transmitting and distributing St. Lawrence current in various parts of the state, and the latter based upon the actual experiences of the more important utility systems operating in New York State. The figures derived may be open to challenge because of differences of opinion on various points; the relative costs, of significance in establishing the causes of spread between generation cost and selling price, are, however, of unquestionable validity.

The marketing report places the cost of generating current at Massena Point, at 100 per cent load factor, in the plant designed by the engineering advisers, at 1.38 mills per kilowatt-hour. But if current were delivered to New York City on a 10 per cent load factor only one-tenth of the possible output would be used. The actual cost of the portion used, at the power plant, would become 1.38 cents, and the cost to a small householder in New York City, if there were no other customers, would become 18.43 cents.

In the space available for this discussion it is proposed first to set forth the ideal method by which the cost of St. Lawrence current retailed in New York City was obtained, and then to present for comparative purposes a study of costs as they actually exist in the same city in the territory served by the New York Edison Company, of the Consolidated Gas system.

New York City has been chosen from the various communities on which the report touches chiefly because there are available correlative data to bring the figures in the report into usable shape for our purpose. Of the New York City companies, New York Edison is taken merely as typical. Because the St. Lawrence study was not directed to the ends we now serve, not all of the information we require is contained in the commission's report. The rest, however, has been taken from exhibits prepared by the company last year in connection with a rate case still pending before the New York Public Service Commission. All figures used here are from one of these two sources.

The St. Lawrence report sets up, for purposes of study, a complete system as it might be constructed today if New York City were entirely without electric service and had to bring it all from the St. Lawrence. It is assumed that the project will be financed exclusively with 5 per cent bonds, will pay no taxes, will operate without profit and will be amortized out of income in 50 years.

Generation cost about 1½ cents

The development will have an installation of 1,100,000[1] turbine horsepower capacity under 86-ft. head and is estimated to cost $90,000,000 for construction. Annual charges of $6,600,000 are computed as follows:

[1] *All figures in connection with generation are half those in the report, since only half the current, cost, etc., belong to New York.*

Direct operation	$107,500
Maintenance, repairs, to machinery and apparatus	64,500
Maintenance and repairs to structures	65,000
Liability and fire insurance	38,500
Management	125,000
Renewal fund (23 years) for machinery and equipment	518,500
Accrued depreciation fund (37 years), superstructure	49,500
Accrued depreciation fund (37 years), for substructures, etc., and machinery parts imbedded in masonry	130,000
	$1,198,000
Interest, 5 per cent on $90,000,000 capital cost	4,500,000
Amortization (37 years)	900,000
Total annual charges	$6,598,000

The capacity of the plant is considered as 605,000 kw. Power losses in trunk transmission lines are estimated at 10 per cent, losses in the distribution system at 20 per cent and an allowance of 15 per cent of capacity is made for diversity. The total delivered load is approximately 505,000 kw., or 443,000,000 kw.-hr. at 10 per cent load.[2]

The generating cost of each kilowatt-hour actually billed to a small domestic user in New York City, then, would be 1/443,000,000 of $6,600,000, or 1.49 cents.[3]

Transmission cost similar to generation in magnitude

To bring St. Lawrence current to New York City a complete, independent trunk transmission system is assumed. In the report a load of 480,000 kw. was assumed to be delivered to a receiving substation at Elmsford, N. Y., 30 miles from the city lines. This gives the same unit cost as though we redesigned the system for the larger quantity (505,000 kw.) with which we are dealing, so the figures from the report are taken, for our purpose.

Seven circuits of 220-kw. capacity each were assumed from Massena Point to Elmsford, at a capital cost of $28,000 for each of the 2,275 circuit-miles, with a receiving substation at Elmsford costing $2,400,000. The entire capital cost is $66,100,000.

On the trunk transmissions annual carrying charges[4] of 8 per cent were built up as follows for each mile:

Patrol	$37.50
Maintenance and repairs	92.50
Liability insurance	10.00
Renewal fund (30 years)	418.00
	$558.00
Interest, 5 per cent of $28,000	1,400.00
Amortization (37 years)	280.00
Total annual charges	$2,238.00

(This is 7.99 per cent of the capital cost per mile, $28,000)

An allowance of $525,000 a year is made for operation and maintenance of the Elmsford receiving substation, and because of the generosity of this amount the 8 per cent figure is applied for annual charges on this plant. The aggregate annual costs for transmission, then, are $525,000 plus $5,288,000 (8 per cent of $66,100,000), or $5,813,000. This is divided among 420,480,000 kw.-hr. a year (480,000 kw. at 1 per cent load) to give a

[2] *Of the 751,861 residential and commercial customers of New York Edison in May, 1930, 661,915 used not more than 95 kw.-hr. each for the month, which gives them individual load factors, based upon a recent Chicago study based upon actual measurements, of somewhat under 10 per cent.*

[3] *The losses resulting in the 505,000 delivered kilowatt-hour figure assume division of output throughout the state, but use throughout of the same units leaves proportions unaffected.*

[4] *The figures given in the report, for double-circuit, are halved here.*

Estimated Cost of St. Lawrence Energy Delivered by State-Owned System to Different Load Centers

(Based on table from page 102 of St. Lawrence report)

Based on 5 per cent interest and delivery cost in cents per kilowatt-hour at low-tension terminals of receiving station transformers.

Buffalo **Load factors →**	0.10	0.30	0.50	0.80	1.00
Generation	1.38	0.46	0.28	0.17	0.14
Transmission	1.30	0.43	0.26	0.16	0.13
Totals	2.68	0.89	0.54	0.33	0.27
Syracuse					
Generation	1.33	0.44	0.27	0.17	0.13
Transmission	0.87	0.29	0.17	0.11	0.09
Totals	2.20	0.73	0.44	0.28	0.22
New York City					
Generation	1.38	0.46	0.28	0.17	0.14
Transmission	1.37	0.46	0.28	0.17	0.14
Totals to Elmsford	2.75	0.92	0.56	0.34	0.28
Elmsford to New York	1.00	0.33	0.20	0.12	0.19
Totals	3.75	1.25	0.76	0.46	0.47

Estimated Cost of St. Lawrence Energy Delivered Through State-Owned System to Domestic Customers

(Excerpts from page 104 of St. Lawrence report)

Cents per kilowatt-hour; based on 5 per cent interest. It will be noted that the unit costs of generation in this table are somewhat higher than those shown in other tables. This seeming discrepancy is due to the fact that the amount of kilowatt-hours delivered to domestic customers is smaller than the amount delivered wholesale at load centers, on account of additional losses in the distribution systems.

Average for All Consumers

	Cents per Kw.-Hr. Delivered		
Load Factors →	0.10	0.20	0.30
Generation	1.49	0.74	0.50
Transmission	1.52	0.76	0.51
Distribution	16.40	8.20	5.46
Total	19.41	9.70	6.47
Credit surplus kilowatts at 0.1 cent	1.08	0.48	0.28
Net total—all consumers	18.33	9.22	6.19
Metropolitan (New York City)			
Generation	1.49	0.74	0.50
Trasmission	1.44	0.72	0.48
Distribution	16.58	8.28	5.52
Total	19.51	9.74	6.50
Credit surplus kilowatts at 0.1 cent	1.08	0.48	0.28
Net total—New York City	18.43	9.26	6.22
Urban*			
Generation	1.49	0.74	0.50
Transmission	1.63	0.81	0.54
Distribution	11.71	5.86	3.91
Total	14.83	7.41	4.95
Credit surplus kilowatts at 0.1 cent	1.08	0.48	0.28
Net total—urban	13.75	6.93	4.67
Rural†			
Generation	1.49	0.74	0.50
Transmission	1.63	0.81	0.54
Distribution	23.82	11.93	7.93
Total	26.94	13.48	8.97
Credit surplus kilowatts at 0.1 cent	1.08	0.48	0.28
Net total—rural	25.86	13.00	8.69

*Urban, communities of 2,500 or more, exclusive of New York City.
†Rural, communities of less than 2,500, and farms.

Charges to Residential Customers for Various Amounts of Energy in New York State

(Utility systems 1930; based on tables on page 128 of St. Lawrence report.)

Company	Territory	Minimum Monthly Bill (Six Customers per Mile)	40-Kw.-Hr. Amount of Bill	40-Kw.-Hr. Cents Per Kw.-Hr.	80 Kw.-Hr. Amount of Bi	80 Kw.-Hr. Cents Per Kw.-Hr.
New York Pwr. & Lt. Co.	Mountain District.....	$4.00	$4.00	10.00	$6.44	8.05
Rochester Gas & Elec. Co.	Allegany and Wyoming Counties....	4.05	4.05	10.13	4.98	6.23
Rockland Light & Pwr. Co.....	Townships, Orange and Sullivan Counties....	6.35	7.95	19.88	9.55	11.94
Central Hudson G. & E. Corp.....	Dutchess County.....	4.00	4.00	10.00	4.75	5.94

Municipal Charges to Residential Customers for Various Quantities of Energy in New York State

Selected municipal systems 1930. The amount of each bill was derived from the rate schedules obtained from the municipalities listed. Where, for the given quantity of energy, the consumer could choose from several schedules, the one allowing the lowest payment was used. The bills are net, where discounts for cash are allowed.

(Five highest and five correct rates table from page 129 of St. Lawrence report)

	20 Kw.-Hr.		40 Kw.-Hr.		90 Kw.-Hr.	
Municipality	Amount	Per Kw.-Hr., Cents	Amount	Per Kw.-Hr., Cents	Amount	Per Kw.-Hr., Cents
Angelica.....	1.98	9.9	3.96	9.9	8.91	9.9
Castile.....	2.00	10.0	4.00	10.0	9.00	10.0
Dunkirk.....	1.20	6.0	2.40	6.0	4.60	5.1
Gilbertsville....	3.60	18.0	6.30	15.8	13.05	14.5
Ilion.....	1.17	5.9	2.34	5.8	3.78	4.2
Jamestown.....	.80	4.0	1.60	4.0	3.30	3.7
Little Valley....	1.20	6.0	2.40	6.0	5.40	6.0
Penn Yan.....	1.22	6.1	2.25	5.6	4.60	5.1
Salamanca.....	.90	4.5	1.80	4.5	3.69	4.1
Sherbourne.....	2.60	13.0	5.05	12.6	6.25	6.9
Speculator.....	2.40	12.0	4.80	12.0	10.80	12.0

Rates to Urban Customers in New York State

(Based on tables on page 128 of St. Lawrence report)

Company and Territory	Minimum Monthly Bill $	20 Kw.-Hr. Amount $	20 Kw.-Hr. Per Kw.-Hr. Cents	40 Kw.-Hr. Amount $	40 Kw.-Hr. Per Kw.-Hr. Cents	90 Kw.-Hr. Amount $	90 Kw.-Hr. Per Kw.-Hr. Cents
N. Y. Edison Co., U. E. L. & P. Co., N. Y. & Q. E. L. & P. Co.		1.40	7.00	2.80	7.00	6.30	7.00
Bronx Gas & Electric Co.....	1.00	1.70	8.50	3.10	7.75	6.60	7.33
Brooklyn Edison Co.....	12.00*	1.40	7.00	2.80	7.00	6.30	7.00
Westchester Lighting Co.....	1.00	1.95	9.75	3.85	9.63	8.60	9.55
N. Y. Power & Light, Albany...	0.75	1.60	8.00	2.55	6.38	4.05	4.50
Syracuse Lighting Co.....	0.90	1.50	7.50	2.10	5.25	3.60	4.00
Buffalo General Elec. Co.....	.75	.95	4.75	1.75	4.38	2.63	2.92
Northern N. Y. Utilities, Inc., Rome.....	1.00	1.80	9.00	2.80	7.00	4.80	5.33
New York State Elec. & Gas, Binghamton.....	1.00	1.80	9.00	2.70	6.75	4.70	5.22
Rochester Gas & Elec. Corp....	1.00	2.05	10.25	2.85	7.13	4.85	5.39
Central Hudson Gas & Electric Corp., Poughkeepsie, Beacon.	1.00	2.00	10.00	3.20	8.00	5.10	5.67

* Year.

Notes—The amount of each bill was derived from the rate schedules filed with the Public Service Commission. Where for the given quantity of energy the consumer could choose from several schedules, the one allowing the lowest payment was used. The bills are net, where discounts for cash are allowed. The last four columns state the amount and unit cost in each block succeeding the first.

kilowatt-hour cost, without distribution losses, of 1.37 cents. But in distribution further losses were assumed to amount to 20 per cent, minus the 15 per cent diversity allowance, or 5 per cent net. The transmission cost per kilowatt-hour actually billed to our supposititious householder becomes 1.44 cents.

Distribution entails large cost item

If the power is to be distributed in New York, 30 miles of expensive underground transmission will be necessary in addition to the trunk transmissions already provided. The capital cost is estimated at $67 a kilowatt[5] for 132-kv. cables with an approximate capacity of 80,000 kw. each. Fixed charges of 10 per cent are applied to this $36,481,500 system, and annual operating charges of $2 per kilowatt[5] bring annual charges on these facilities to a total of $4,737,150.

For actual distribution in New York City facilities are assumed to cost $283,150,000, of which $17,500,000 is for administration buildings, $15,650,000 for buildings and equipment for operation and maintenance and $250,000,000 for actual distribution facilities. The same 10 per cent charges are applied to this capital cost.

The annual charges to be distributed among 443,000,000 kw.-hr., then, become $28,315,000 capital costs on distribution facilities in New York City, $4,737,150 charges on Elmsford-to-New-York transmissions, $40,400,000 ($80 a kilowatt[6] on 505,000 kw.) for operating expenses of distribution, a total of $73,452,150, or 16.58 cents, for each kilowatt-hour billed to customers.

We now have the following costs for St. Lawrence power distributed in New York City on a 10 per cent load factor: Generation, 1.49 cents; transmission, 1.44 cents; distribution, 16.58 cents; a total of 19.51 cents. From this 1.08 cents is deducted on the theory that the 90 per cent of the plant's capacity unused by these customers can be sold at the site for 1 mill per kilowatt-hour. The delivered cost per kilowatt-hour distributed at 10 per cent in New York City is 18.43 cents.

Here in a state system, operated without profits and with low-cost money, is a spread of 1,330 per cent between generation cost and delivered-to-appliance cost. It should be observed that this is hydro-electric power, which must be generated where the water falls and is not useful until brought to the load center, where the cost still compares favorably with locally generated steam power. If we consider the cost at Elmsford as production cost, the spread remains 720 per cent. To meet the further objection that this 720 per cent spread is only 65 per cent as great as the spread between 6-mill power sold at 7 cents, it need only be noted that the 6 mills is merely operating cost, and takes no account of capital charges which were included in our study of St. Lawrence hydro power. An even better course, however, is to go to the actual figures for energy generated by steam in New York City.

New York Edison generates under 1 cent

The New York Edison Company sold in 1929 a total of 1,896,897,883 kw.-hr., of which 692,408,359 was sold at retail, 760,416,000 at wholesale and 444,073,524 in

[5] *Distribution losses have not yet been incurred; capacity is for 544,500 kw.*

[6] *This $80 figure is derived from study of experience figures in the annual reports of New York companies to the Public Service Commission.*

"other classifications." Because it purchased much current in addition to that generated in its own plants, and sold some, and lost some in the process of distribution, its kilowatt-hour cost of production was not the 0.587 cent shown by plant operation figures, but 0.830 cent.[7]

Operating costs of generation	$8,527,783	
Energy purchased	7,450,567	
		$15,978,350
Credit, miscellaneous operating revenue		204,816
Net production cost		$15,773,534

Per kilowatt-hour sold $0.0083.

Transmission expenses reported to the Public Service Commission totaled $3,766,861, or 0.20 cent per kilowatt-hour sold. This would be increased somewhat by allocation of facilities between transmission and distribution and by allocation of certain now undistributed general and miscellaneous costs. No reasonable basis for such allocation is available. Since the dividing line in our study is between operating costs of generation and all other costs, there is no reason to segregate these additional transmission charges from distribution, with which they are now included.

Two accounting classifications are taken for our purpose as distribution items. They are set forth in the St. Lawrence report as "Other Expenses, excluding General and Miscellaneous," $14,187,304; and "General and Miscellaneous, excluding Retirement," $8,271,783. They total $22,459,087. Considered as distribution expenses, they apply only to the 1,639,961,581 kw.-hr. sold to other than railways or other electric corporations. On this basis the kilowatt-hour cost of distribution is determined as 1.37 cents.[8]

Edison capital costs add 1.67 cents

It will be observed that all expenses considered thus far have been for operation. Each of the three general categories would be increased considerably if capital costs attributable to it were added. There are a number of methods by which these capital charges might be allocated. But since they all come after operating costs of generation, such allocation does not concern us.

For our purpose it is sufficient to determine the aggregate capital charges per kilowatt-hour. Even here there is difficulty, because of differences of opinion as to the elusive "fair return on a fair value." This may be ignored until we come to dividends:

		Per Kw.-Hr.
Retirement charges	$6,252,237.71	$0.0033
Taxes	6,715,604.53	0.0036
Interest, fixed charges	5,558,090.22	0.0029
Total, exclusive of dividends	$18,525,932.46	$0.0098

In considering the allowance for dividends, I have simply preserved the *status quo* without prejudice to any one who wishes to argue that it should not be preserved. As a matter of actual fact, in 1929 the company paid $3.75 for nine months on each of 4,300,000 common shares and $1.25 for three months on each of 5,200,000 shares, a total of $22,625,000, of which $9,567,063 was received from non-operating revenues. The remainder, $13,057,937, constitutes a charge of 0.69 cent on each kilowatt-hour sold.

We have now shown costs per kilowatt-hour, for the New York Edison Company, of 0.83 cent for production, 0.20 cent for transmission, 1.37 cents for distribution and undistributed expenses, 0.98 cent plus 0.69 cent for capital charges, a total of 4.07 cents.

The company's income in 1929 from operations amounted to $80,839,789.82, or 4.26 cents for all sales including railways and other electric corporations. This appears to exceed cost by 0.19 cent a kilowatt-hour and provides an annual contribution to desirable surplus.

The company operates on a 43½ per cent load factor. On this load St. Lawrence current, distributed in New York by the state system described earlier in this article, would cost 4.24 cents a kilowatt-hour, 0.02 cent less than the actual cost of steam-electricity produced and distributed by the private company. The two costs are close enough to allow speculation as to how this expense of 4.24 (or 4.26) cents for the average kilowatt-hour should be apportioned among the various classes of customers, having regard for load factor, amount and time of use, etc. Here again we may have recourse to tables prepared by the St. Lawrence commission's marketing experts, extending and interpolating where necessary to show costs at the significant load factors of 10, 15, 20, 25 and 35 per cent.

Small customer cost same from both sources

Of the 751,861 domestic and commercial customers served by New York Edison Company in the typical month of April, 1930, 661,915 used up to 95 kw.-hr. each per month and provided a class load factor of not more than 10 per cent. In actual practice, of course, a group of customers each having a 10 per cent load factor would have a group load factor considerably higher—perhaps 15 per cent—and several groups with varied uses and characteristics would have an aggregate load factor higher than any one. Otherwise the cost of electricity would be so exorbitant as to discourage most uses. The cost of supplying current to a group of customers with this load factor, from either the St. Lawrence or New York Edison plants, would approximate 18 cents a kilowatt-hour.

The second largest class, 57,725, used from 96 to 300 kw.-hr. each, and on a 15 per cent load factor would cost about 12 cents a kilowatt-hour to serve. Of the entire group of these customers, only 4,103 commercial users, purchasing each more than 3,001 kw.-hr. a month, could be served on their individual load factors of 35 per cent for less than the 7 cents actually charged to all users of less than 1,000 kw.-hr. a month. The cost to this class would be a trifle more than 5 cents.

The tendency of a group to have a higher load factor than any of the members, however, is common to all classes of use and does not affect appreciably a comparison of group costs with group rates. Even with it, the householders as a group receive current at a much lower cost per unit than they could if no other classes were served, while at least some other classes pay more than if they alone were served. The customer who, by himself, would cost 18 cents to serve cannot object to paying more than another customer who, by himself, could be served for 5 cents. The discrepancy becomes

[7] *Unless specifically noted, all figures on New York Edison are as of 1929, the latest complete year for which information was available when the St. Lawrence Power Development Commission's report was being prepared. It should be noted that the justice of any figure is not passed upon by the writer, who simply records reported facts; this applies, for instance, to the price paid for energy purchased, which usually came from closely affiliated companies.*

[8] *This checks closely with the 1.40 cents reported as distribution cost by the company in the rate case exhibits cited above.*

much greater, of course, if we consider the administrative costs per kilowatt-hour for the user of 32 kw.-hr. a month as contrasted with those of the user of 3,000 kw.-hr. a month.

The New York Edison Company received 6.44 cents for the average kilowatt-hour retailed in 1929, 3.51 cents for the average kilowatt-hour wholesaled and 1.87 cents for the average kilowatt-hour sold in "other classifications." The price to residential users of 1,000 kw.-hr. a month, or less, was 7 cents.

When it is borne in mind that the individual load factor of 90 per cent of the company's customers in the most numerous classes was 10 per cent or less, while the collective load factor of manufacturing establishments is placed by the St. Lawrence report at around 40 per cent, a considerable spread between household and industrial rates seems justified, on this one basis alone.

Whether or not the existing differential between cost of generation and rates to domestic users is fair either to utility or customers is not established by these studies. But they do throw much light on existing and ideal reasons why some such differential is inevitable, and they do point out many of the factors which enter into the determination of its amount.

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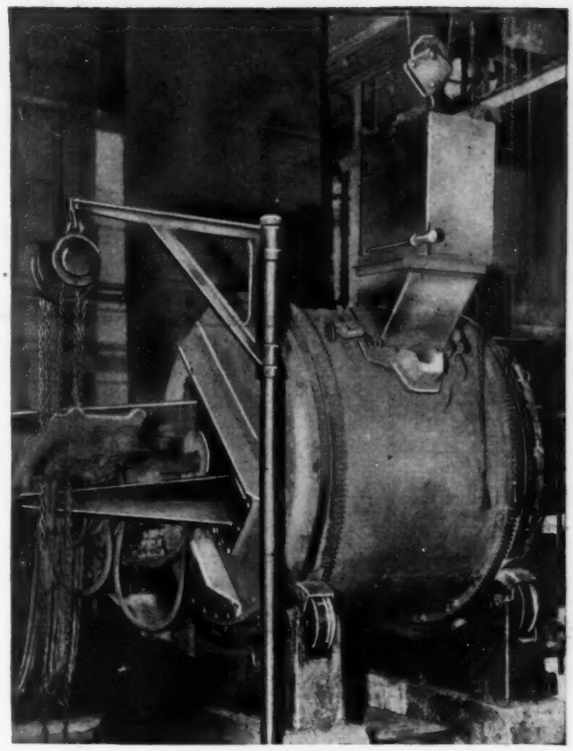
Electric Furnace Speeds Production of Iron Castings

Flexibility of operation, continuous production and superior quality of output in the making of gray and malleable iron castings of great diversity of size and shape convince the York Ice Machinery Corporation of the greater advantage of the electric furnace for this work even though other methods of melting may show lower costs per ton at the pouring spout. Such is the statement of J. C. Bennett, metallurgist, and J. H. Vogel, assistant superintendent, of this company in a paper, presented at the recent convention of the American Foundrymen's Association, in regard to the operation of a 1-ton Detroit Electric indirect arc furnace. The melting cost per ton of metal, presented in this paper, exclusive of supervision and rent, amounts to $15.70, divided as follows: Power, $7.93; refractories, $2.55; electrodes, $1.82; labor, $1.40; interest, depreciation and repairs, $2.

The normal gray iron charge consists of 60 per cent borings at present market price of $6.50 per ton and 40 per cent of scrap valued at $14 per ton. The necessary ferro-silicon averages $1.25 per ton, making a total material cost per ton of $10.81.

One of the chief advantages of the electric furnace is its flexibility, or the ease by which the chemical and physical properties of the iron can be changed at will. For example, during one day's run of six heats as many as four different kinds of iron have been poured, namely, ordinary gray iron for small-pressure castings, low-carbon gray iron with 2 per cent nickel for manifolds, high phosphorous iron for piston rings and, finally, malleable iron for large connecting rods. A representative daily furnace report is shown here. A second advantage of the electric furnace lies in the fact that the cheapest kind of raw material can be used. To the normal gray iron charge of scrap as shown above is added the necessary ferro-silicon to prevent undue hardness, and for certain classes of complicated thin-walled castings steel is added to close the grain.



Furnace is easily charged

Bottom dump buckets holding 700 lb. are loaded and brought to the furnace by electric trucks. Prior to charging, a steel funnel is hung on the door bolts and the furnace rotated until the door is in the 45-deg. position. The bucket is raised by an electric hoist, moved into position over the funnel and the bottom dropped. With these buckets 1 ton of metal can be charged in less than five minutes.

ELECTRIC FURNACE REPORT—YORK ICE MACHINERY CORPORATION

DATE 7/1/30 FURNACE No. 1 OPERATOR Flicker REPORT No. 113

		1	2	3	4	5	6	7	8	9	10
Day Heat Number		147	148	149	150	151	152				
Lining Heat Number		5:10	7:00	9:00	10:55	12:45	2:00				
Time Arc On		5:00	7:00	9:00	10:55	12:45	2:00				
Time Started Rocking		0	0	0	0	0	0				
K.W. Hrs. Started Rocking		6:30	8:30	10:30	12:15	2:00	4:00				
Time Arc Off		600	570	560	550	540	580				
K.W. Hrs. - Total		2240	2230	2230	2230	2220	2900				
Metal Temperature °F											
Composition and Analysis of Charge	Borings	1200		1200	1200	1200					
	Sprue	800	840	800	800	800	2000				
	Pig		1100								
	Steel		60	15		15	20				
	Nickel			36		36					
	Ferro Sil.	16		16	16	16					
	Ferro Phos.										
Total Wt. of Charge		2016	2000	2067	2016	2067	2020				
Type Castings Poured		Small Fittings	Piston Rings	Manifolds	Small Fittings	Manifolds	Conn. Rods				

Remarks: #2 Heat Piston Rings
#6 " Malleable Iron

Diversity of products demonstrates furnace flexibility

Both malleable and gray iron castings are shown by this report in one day's production.

New Indoor Type Metal-Clad Switchgear Installed in Detroit

By C. S. LUMLEY* and G. L. CLAYBOURN†

AN INSTALLATION consisting of eight 24,000-volt, oil-filled, indoor type, vertical lift, metal-clad switchgear units in its Joy Road substation has recently been placed in service by the Public Lighting Commission of the city of Detroit. There are some features of this indoor use of equipment heretofore regarded as of outdoor design that make the Joy Road installation rather exceptional. An economic analysis showed that the cost of metal-clad switchgear was approximately 12

*Electrical Engineer Smith Hinchman & Grylls, Detroit, Mich.
†Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

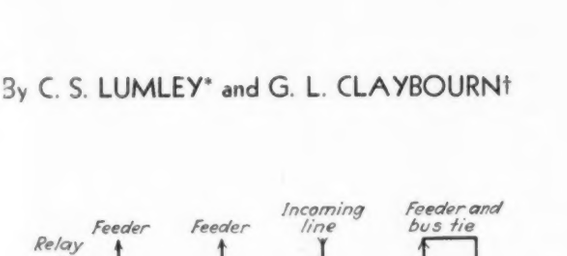


Diagram shows fault bus arrangement

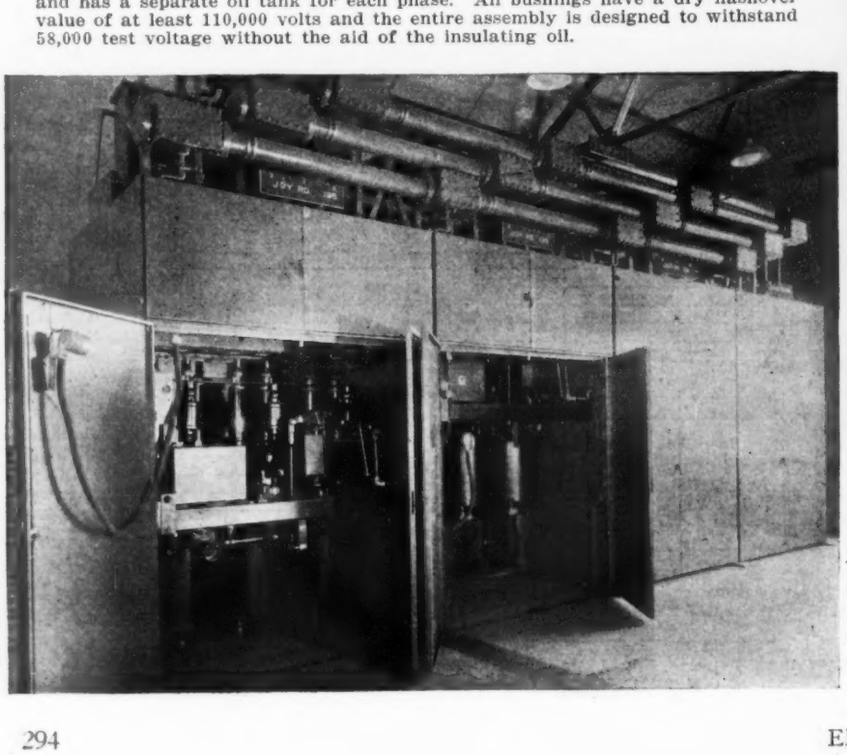
The steel framework is mounted on micarta plates and fastened to the floor steel with insulated bolts. The structure is then connected to the ground through the fault bus current transformer which actuates the protective relay.

Potential transformer fuses pull out

The potential transformers are equipped with Schweitzer & Conrad primary fuses assembled in disconnecting type holders. When the fuse holder is withdrawn from the stationary insulated casing both the primary and secondary circuits to the transformer are disconnected. The high-voltage contacts are disconnected under oil and the handle to the fuse holder is grounded, insuring maximum protection to the operator when renewing fuses.

Switches are inclosed, but easily accessible

First circuit breaker to the left is in the test position. The second circuit breaker is in the operating position. Each oil circuit breaker has a continuous carrying capacity of 600 amp. with a rupturing capacity of 500,000 kva. at 25,000 volts and has a separate oil tank for each phase. All bushings have a dry flashover value of at least 110,000 volts and the entire assembly is designed to withstand 58,000 test voltage without the aid of the insulating oil.



per cent more than the conventional type of open and cell-contained equipment. This difference in capital costs takes into consideration all related factors, including space requirements and resultant differences in building costs, and may appear excessive at first glance. However, when all the advantages of metal-clad switchgear are taken into consideration this difference is entirely offset, as many of these advantages can be capitalized, the capitalization depending, of course, upon the values which are placed on the items involved. These advantages are safety, reduced costs of engineering and installation, higher salvage value, lessened maintenance and increased operating flexibility.

Switchgear of unit type

The switchgear was all factory built and assembled by the Westinghouse Electric & Manufacturing Company and is of the unit type, arranged in two rows facing each other, with a center aisle of adequate width to facilitate quick and easy removal of units and transference to a test rack for inspection and test. All connections are made from below. All live parts are inclosed in grounded metal, and phase to phase shorts are prevented by the isolation of each bus in an oil-filled metal inclosure tapped at the breaker units by condenser bushings, extending through the oil-filled compartment into the breaker disconnecting compartment. Each terminal of the bus and breaker is isolated from all other terminals in this metal compartment by the use of long porcelain tubes. This type of construction protects the main bus from moisture, dust, smoke, vermin and ionized gases caused from secondary short circuits.

When the breaker unit is withdrawn from the cell automatic shutters move into position below the six openings to the porcelain tubes for the circuit breaker poles, thus preventing accidental contact with the stationary contacts extending downward from the main bus. Provisions are made, however, whereby access can be gained to the cable side of the unit for phasing purposes.

Feeder circuits are connected to the switchgear in a separate metal compartment, and condenser bushings reach downward into this compartment from oil-filled current transformer boxes. Cables extend up from the bottom of the compartment and through porcelain bushings of suitable potheads, arranged in such a manner as to provide for quick and simple interchange of phases to insure correct phase rotation after cable replacements. These connections are all taped for full voltage and are the only ones, other than the primary disconnecting devices between the oil circuit breaker and the bus, which are not oil insulated. Ample spacing in air is provided and the assembly completely inclosed with removable sheet metal covers on the rear of the structure.

All oil-filled compartments are connected to conservator tanks by a system of pipes which allow for expansion and contraction of the oil. The conservator tanks are equipped with dehydrating breathers which remove the moisture from the air drawn into the tanks during the contraction of the oil. The piping system is equipped with suitable valves to facilitate oil filtering. Insulation can be assured by frequent checks of oil samples drained from sampling valves conveniently located at low points on the compartments. A second installation, of the same rating and design as the present one, is now in the process of manufacture and will be placed in service in the near future.

Relative Measurement of Magnet Strengths

To measure the field strengths of meter magnets in simply a relative way is usually sufficient for the ordinary purposes of a utility meter laboratory. It is not necessary that the strengths be determined in absolute units. A method of ascertaining these relative values has been developed in the meter department of the Cumberland County Power & Light Company and is described in a recent serial report of the meter committee, Engineering National Section, N.E.L.A., on new developments in electrical measuring and auxiliary testing devices. A neon lamp operating from a 60-cycle circuit, a watt-hour meter with its disk marked for stroboscopic testing, an indicating wattmeter and a variable resistor are used in this method. The magnets and register are removed from the watt-hour meter and a jig is provided to locate the magnet under test in proper position with respect to the disk. The procedure consists in varying the speed of the meter, with the magnet to be tested held in place until the disk markings appear to stand still, and then reading the load on the indicating meter.

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Cost Allocations Detailed By Sydney

Sydney's municipal electrical enterprise in New South Wales issues an unusually complete analysis of its year's operations. This utility in 1930 had 194,565 customers connected and generated for all purposes 410,151,500 kw.-hr., an average sold per customer of 1,920 kw.-hr. per year. On the other hand, the total investment is reported to be £17,339,341, which means 19.2 kw.-hr. sold per £ of capital investment, or about 3.95 per dollar. Power sales represent 35.7 per cent, one-meter rate sales 32.8 per cent, commercial 14.7 per cent; the corresponding average prices in pence (2 cents) are 1.058, 2.332, 2.454, with the additional figures of 2.232d. for residence service and 1.8d. for street lighting. Cost allocations are carried out in considerable detail, condensations of which appear in the accompanying tables.

Costs per Kilowatt-Hour Generated

	Pence	Per Cent		Pence	Per Cent
Generation	0.33	18.73	Depreciation	0.31	17.40
Distribution	0.22	12.71	Miscellaneous	0.06	3.08
Management	0.18	9.86			
Interest	0.59	33.48	Total	1.77	100.00
Sinking fund	0.08	4.74			

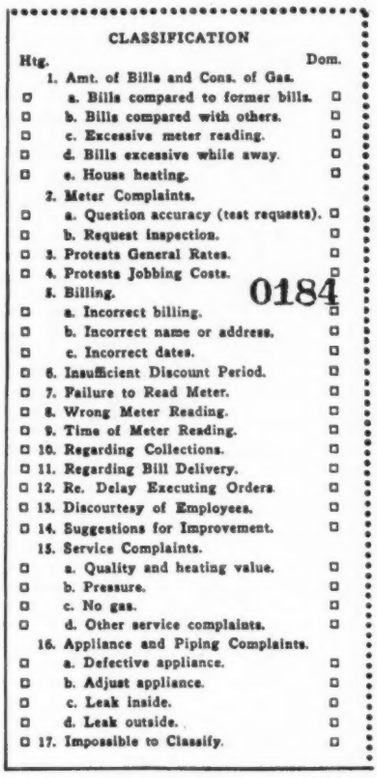
Per Cent Distribution of Capital Expenditures

Power stations (two)		Public lamps	1.2
Land and buildings	11.5	Meters	3.4
Machinery and apparatus	20.9	Motors for rental	0.4
Substations		Furniture and fittings	0.5
Land and buildings	4.2	Plant and tools	0.5
Machinery and apparatus	14.0	Motor vehicles	0.4
Underground mains	24.7	Buildings, warehouses, yards	1.5
Overhead mains	10.6		
House services	6.2	Total	100.0

Procedure that Helps in Handling Customer Complaints

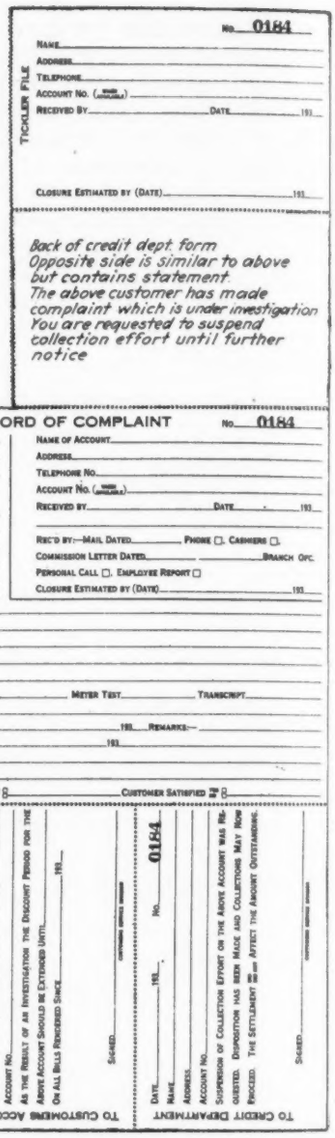
Two months' use of a new method of handling customers' complaints has convinced the Washington (D. C.) Gas Light Company that it will be of decided helpfulness in maintaining a mutually satisfactory relationship between the company and its patrons. The primary purposes of the plan are to prevent neglect in the adjustment of complaints and, by proper co-ordination of the customers' service division and the accounting department, to suspend efforts to collect bills during the period intervening between the filing of a complaint and its adjustment.

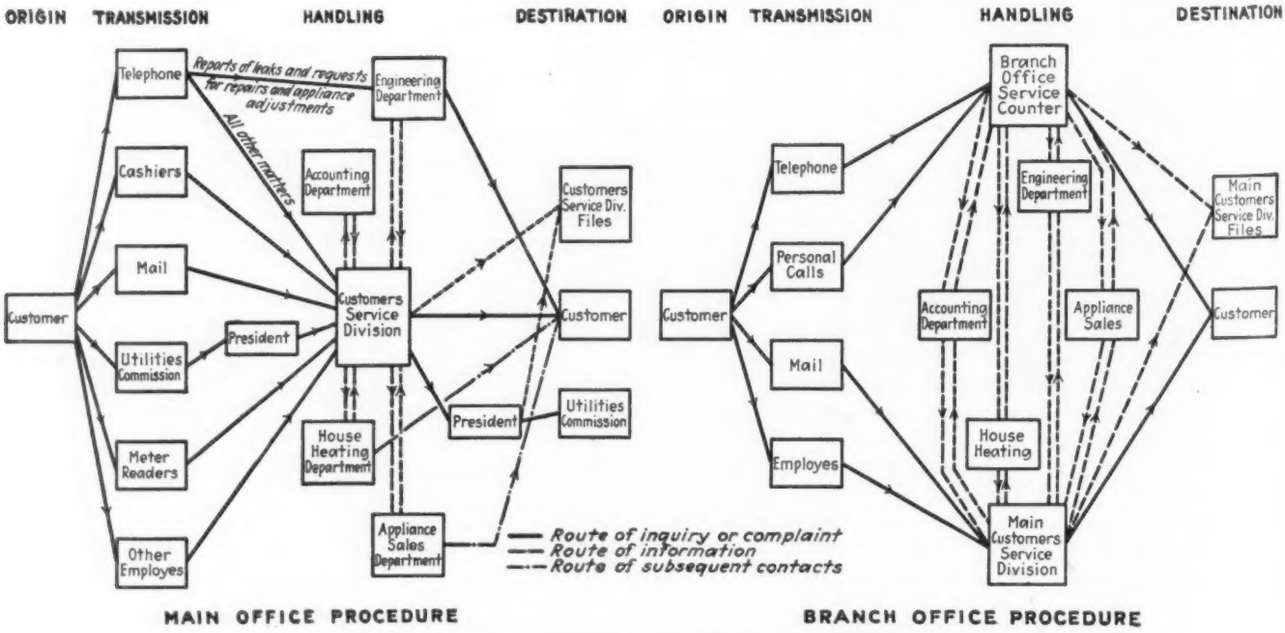
The essential feature of the plan is the record that is made of each complaint and the manner in which it is routed through the company's offices. Other companies may find it advantageous in handling complaints to adopt the form devised for this purpose. There is a reason for the peculiar shape of the form, which is reproduced herewith. The two uppermost tabs are designed respec-



Types of inquiries recorded on form

Perforated form used in handling inquiries and complaints





Routing for customers' inquiries and complaints

tively to serve as a "tickler" for the employee investigating the complaint and as a notice to the credit department to suspend collection effort until further notice. These can fold over so that they and the upper right section can be filled in triplicate by carbon. The lop-eared shape of the form is a practical preventive to displacing or filling the record of the complaint until these two sections have been routed to the investigator's tickler file and the credit department.

After the complaint is disposed of the customers' service division notifies the credit department to proceed with collection on the customer's accounts, using the appropriate section of the form for this purpose, and also notifies the customers' accounting department if the discount period for the account should be extended.

A classification of the causes of complaint is made for the convenience of the customers' service division in determining the number and frequency of complaints of various kinds. This is readily accomplished through the use of the section of the record of each individual complaint on which its nature is checked.

Records of customer's complains are serially numbered in order to avoid any confusion. The provisions made for the necessary entries on this record are self-explanatory. The question whether the customer is satisfied with the disposition made of his complaint indicates whether a follow-up call by the appliance sales department or, possibly, the house-heating department is desirable to restore the customer's good will.

This procedure was developed by Bert H. Peck, who recently became assistant to G. A. C. Wood, president of the company.

Frequency of Inspection, Testing and Overhauling

Compiled by Electrical Apparatus Committee, N.E.L.A.

Oil Circuit Breakers—24 Companies Reporting

Complete overhaul inspection made even though the breaker may not have been subjected to heavy duty, may not have thrown oil and the oil of which may not have tested below standard.

	Sub-stations	Power and Trans. Stations
Biennially	3	..
Annually	10	14
Semi-annually	4	4
6-12 trip-outs	1	1
Cumulative duty score	5	5

Breakers operated periodically to determine if they are mechanically operative and that the control circuits and mechanisms will function.

	Sub-stations	Power and Trans. Stations
Cumulative time score	1	1
Weekly	4	5
Bi-weekly	1	2
Monthly	7	6
Bi-monthly	2	1
Quarterly	2	3
Semi-annually	2	1
Annually	1	..
Not at all	1	1

Tests determine speed of operation.

	Sub-stations	Power and Trans. Stations
Annually	4	5
Semi-annually	3	3
At initial installation only	6	5
Operation questioned	4	5

Bushings tested.

	Megger Test	Doble Test
Annually	6	1
Semi-annually	6	..
Quarterly	2	..
Not at all	5	4
Have made one test	..	3

Relays—22 Companies Reporting

Completely tested and inspected, including the control circuits.

	Sub-stations	Power and Trans. Stations
Quarterly	2	2
Every four months	3	2
Semi-annually	7	8
Annually	8	9
Only when found faulty or when changing settings	1	1

Transformers—24 Companies Reporting

Opened for inspection for loose connections, sludging of oil, obstruction to oil ducts, rust under cover, dirt on terminal board, etc.

	Sub-stations	Power and Trans. Stations
Annually	2	4
Semi-annually	2	1
Not at all	2	2
Upon evidence of bad conditions	16	16
Five years	1	1

Rotating Machinery—22 Companies Reporting

Inspection, testing and overhauling frequency.

	Sub-stations	Power Stations
Annually	17	17
Biennially	1	1
Semi-annually	2	1
Quarterly	1	2
Service hours	..	1

Frequency of megger tests.

	Sub-stations	Power Stations
Monthly	3	10
Quarterly	4	2
Semi-annually	3	1
Annually	5	1
After repairs	3	6
Not at all	3	2

Oil for High-Voltage Breakers and Transformers—23 Companies Reporting

Interval between oil samples.

	Breakers	Trans-forms
Monthly	4	4
Quarterly	7	8
Semi-annually	5	4
Annually	5	7

Induction Regulators—20 Companies Reporting

Thorough inspection, including control equipment and motors, in addition to the normal tests performed by the operator on each shift.

Monthly	5
Quarterly	5
Semi-annually	5
Not at all	4
Biennially	1

Electrolytic Arresters—17 Companies Reporting

Detanked and inspected.

Every three years	5
Every two years	3
Annually	2
Semi-annually	2
On condition of charging arc	5

Automatic Non-Attended Distribution Substations—17 Companies Reporting

Visited and inspected by a qualified inspector.

Daily	5
Every two days	2
Twice a week	1
Weekly	7
Quarterly	1
Monthly	1

READERS' FORUM

Make N.E.L.A. Exhibits Free to All

To the Editor of the ELECTRICAL WORLD:

I have read with great interest your comment on the N.E.L.A. exhibit this year. It is no more than can be expected when a group of manufacturers exhibit to a closed convention like the N.E.L.A.

I am interested in electrical equipment as much as any member of an electrical group, but am barred from seeing the exhibit because I am not a member of the above. I have had, on two occasions, to beat my way into this exhibit, and I have told the representatives of the manufacturers who exhibited there that they were not getting their value because only a select few are admitted. The manufacturers should refuse to exhibit unless the public is admitted for several days during the show period. Even the utilities themselves are losing out, as people who are willing to pay a nominal fee to see it are kept out and thereby antagonized.

I hope that the manufacturers will wake up and demand a real exhibit like the iron and steel electrical engineers conduct and lead in.

WALTER B. MacLEAN,
United States Pipe & Foundry Company, Electrical Engineer.
Burlington, N. J.

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Opposed to Engineering Licenses

To the Editor of the ELECTRICAL WORLD:

I am very much in sympathy with the opinion of M. M. Samuels which appeared on page 210 of the ELECTRICAL WORLD of August 1, 1931, under the title "Engineer's License, Plumber's License and Dog's License." The comments of the editor at the end of the letter are also interesting.

It is easy to understand that the editor, if engaged in engineering practice, would have a license if same were required by state law, but it is not so easy to understand how the possession of such a license by him and all the other men engaged in engineering practice would lift engineering practice out of trade levels into professional respect. It is certain that very mediocre and sometimes very incompetent men can easily obtain licenses under state law, but how the possession of a license, or his mere registration, can improve the quality of a man's work is beyond my comprehension. In the end, the engineering profession will be judged by the results it produces and not by the number of licenses it holds.

I am opposed to either the licensing or registration of professional engineers because:

First—Neither licensing nor registration of such men can be any guarantee of an engineer's competence or personal integrity.

Second—Either licensing or registration will turn over to the government a little more work, for which some one must pay in fees or taxes. The new office created will require more office space, which will eventually be supplied by the state. It is an extension of bureaucracy which certainly is overdone, to the detriment of the public in our state and nearly all governmental affairs. Bureaucracy is encroaching more and more upon business and other fields of private enterprise and it seems to me that engineers ought to have sense enough to see that proposed licensing and registration laws are only steps in this general movement and should, therefore, be opposed.

G. G. POST,
Vice-President in Charge of Power.
Milwaukee Electric Railway & Light Company,
Milwaukee, Wis.

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BOOK REVIEWS

Statistik der Elektrizitatswerke der Schweiz

Prepared by the Inspectorate for Electric Power (Ing. F. Sibler). Schweizerischer Elektrotechnischer Verein, Seefeldstrasse 301, Zurich, Switzerland. 250 pages.

Extraordinarily detailed information covering operations for the calendar year 1929 is given on individual Swiss electrical establishments. For each of the 99 larger installations 104 items are covered. Most of the items relate to physical equipment and operation; the only financial information is the capital investment. The national summaries at the end of the book are particularly comprehensive. The report is in German and French, in parallel columns.

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Principles of Electricity

By Leigh Page and Norman I. Adams, Jr. D. Van Nostrand Company, New York. 620 pages. Price, $4.25.

Building on the electron theory of matter and reconciling all derivations with the relativity principle, these Yale professors have set up the fundamentals of electrical phenomena in rigid mathematical fashion. Electrical apparatus is emphasized only in so far as it bears on the laboratory technique of measuring the electrical quantities and properties. Dielectrics, fields, magnetics, thermal and chemical relations, circuits, absolute measurements, coupled circuits, filters, waves and oscillations are treated with due regard to power and communication dependence on fundamentals. The book's full scope lies just beyond the customary general physics course and thus elaborates to intermediate level the conventional electrical content. The calculus and differentials are employed throughout.

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The "Electrician" Annual Tables of Electricity Undertakings, 1931

Edited by Leonard F. Shapland. Ernest Benn, Ltd., 154 Fleet Street, London, E.C.4, England. 228 pages. Price, 10s. net (postage additional).

Users of earlier issues of this well-known reference work recognize it as an authoritative source of information regarding electric light and power undertakings throughout the British Empire. It goes into considerable detail regarding physical plant, connected load, output and rates for energy. In addition it similarly covers many of the more important non-British operations throughout the world.

Men of the Industry

L. R. King Assumes New Executive Duties

L. R. KING of Davenport has been named as president and general manager of the Iowa-Nebraska Light & Power Company and the Maryville (Mo.) Electric Light & Power Company, subsidiaries of the United Light & Power Corporation. Mr. King has been assistant general manager of the latter company as well as of the United Light & Power Engineering & Construction Company, with headquarters at Davenport. The work Mr. King has been performing at Davenport as rate

and appraisal engineer for the latter company will be assigned to Warren L. Porter of its staff. Mr. King will remove with his family to Lincoln, where the headquarters of the Iowa-Nebraska company are located. He succeeds Frank H. Brooks, who has become general manager of the Northern Natural Gas company with headquarters at Omaha.

Mr. King entered the service of United Light & Power after graduating from Montana State College at Bozeman, spending two years as a teacher of mathematics at Butte, and four years in the construction work for the Chicago, Milwaukee & St. Paul Railroad Company. In 1911 he became construction engineer for the Davenport & Muscatine Railway Company, owned by United Light & Power, and thereafter his rise was rapid. He is a director of the People's Light Company of Davenport, Iowa City Light & Power Company and several other subsidiaries of United Light & Power.

CHARLES W. CAMPBELL of Topeka has been appointed a member of the Public Service Commission of Kansas. Though Mr. Campbell began his business career in the mercantile business, in recent years he has been identified with banking institutions.

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A. W. LEONARD, chairman and a member of the board of directors of the Puget Sound Power & Light Company, Seattle, Wash., has resigned and the position of chairman has been abolished. W. H. MCGRATH, executive vice-president, was elected a member of the board to fill the vacancy. F. W. BROWNELL, treasurer, and F. E. HOLMAN were elected members of the board to fill the vacancies caused by the resignations of Charles B. Barnes and Bayard F. Pope.

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R. D. BEAN, formerly manager of the engineering development department of the Brown Instrument Company, Philadelphia, Pa., has been made chief engineer of that company. Mr. Bean's extensive field investigations covering many applications of Brown industrial measuring instruments have won him wide acquaintance and his numerous friends will be glad to hear of his promotion.

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B. P. STOCKWELL, Oklahoma manager for the Oklahoma Utilities Company since 1927, has been appointed rate and valuation engineer for the Empire Public Service Corporation, of which the Oklahoma Utilities is a subsidiary. Mr. Stockwell is a graduate of the University of Oklahoma in mechanical engineering and had eight years' experience in rate and valuation work with the Illinois and Oklahoma public service commissions prior to his connection with the Oklahoma Utilities Company.

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WILLIAM S. RICHHART, Fort Wayne, Ind., operating engineer for the northern part of Indiana for the Insull properties, has assumed charge of the distribution service for all Insull properties included in the Midland United Company. Mr. Richhart has been with the Indiana Service Corporation in Fort Wayne since 1917. In May, 1928, he was appointed manager of the company's light and power department and in September, 1929, was appointed operating engineer in that section of the state, having charge of power, water and heating plants, together with high-tension transmission lines and substations.

R. Montgomery Directs Sales Work for Louisville Utility

ROBERT MONTGOMERY, who has been connected with the Louisville Gas & Electric Company since 1914, has recently been elected vice-president of that utility in charge of sales. Mr. Montgomery brings to his new executive position a broad background of experience both in the commercial and operating branches of the electrical industry.

Mr. Montgomery was first employed as an electrician for the United Gas & Electric Company, Jeffersonville, Ind., from 1899 to 1902 and later for the

General Electric Company in the Cincinnati and Ashville offices. In 1906 he became manager of the Hopkinsville Gas & Electric Company, Hopkinsville, Ky., and in 1907 returned to the General Electric Company in Cincinnati as construction foreman.

He left this position in 1908 to become superintendent of the Lebanon Light, Power & Water Company, Lebanon, Tenn.; two years later he became power sales engineer for the Chicago, Lake Shore & South Bend Railway Company, Michigan City, Ind. In 1911 he went with the Fort Worth Power & Light Company, Fort Worth, Tex., as commercial manager. Mr. Montgomery became associated with the Byllesby organization in 1914 when he became commercial manager of the Louisville Gas & Electric Company. He later served in the capacity of manager, investment department, and then general sales manager.

Mr. Montgomery is a member of the National Electric Light Association,

Society for Electrical Development, American Gas Association, Louisville Board of Trade, Kentucky Committee on Public Utility Information, Electric Club of Louisville, Louisville Convention and Publicity League and Kentucky Association of Public Utilities.

MURRAY G. DAY, formerly superintendent of power of the New Bedford Gas & Edison Light Company, New Bedford, Mass., has joined the Dampney Company of America with general offices in Boston. Mr. Day's headquarters are in Chicago.

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OBITUARY

Arthur Wright

ARTHUR WRIGHT, noted English consulting engineer and pioneer in meter engineering, died in England July 28, at the age of 73. He was a native of London and originally intended to enter the medical profession, but took up the study of electrical engineering instead, becoming the first electrical engineer of the Brighton Town Council, in which capacity he installed the Portslade generating station. He was manager of the Brighton undertaking for 25 years.

About twenty years ago he retired from service at Brighton and built up a large consulting practice at London. From that, too, he subsequently withdrew, but was again persuaded to enter the consulting field, and until three years ago was making semi-annual visits to Massachusetts as consultant to the Edison Electric Illuminating Company. He was a member of the Institution of Electrical Engineers for 50 years and conducted a wide variety of researches in electrical measurement.

In commenting on the death of Mr. Wright, Charles L. Edgar, president of the Edison Electric Illuminating Company of Boston, said:

"My acquaintance with Arthur Wright dates back for at least thirty years. We visited him at Brighton when he was the superintendent of the municipal works in that city and formed a personal and family acquaintanceship which has lasted all of these years. At that early date he had just developed the Wright meter and formed a partnership under the name of Wright, Reason & Madgin for the manufacture of these meters in England. An arrangement was made with him about that time for introducing his meters in America and the Boston Edison company used them in large quantities for a good many years.

"Some twenty years ago I made an arrangement with him to visit Boston twice a year and spend two weeks with our people, giving them the latest news as to the developments in Europe and giving us the benefit of his advice as to the problems which were continually arising in our own company.

"With the exception of one year during the war these bi-yearly visits have continued during all this time and they were timed so he could attend the annual convention of the Association of Edison Illuminating Companies. As a result of this acquaintanceship he is probably better known to the rank and file of the Edison people than almost any other man not directly identified with the companies. His last convention was in Quebec a year or two ago. I have always looked upon him as the leading electrical engineer in Europe."

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Homer E. Niesz

HOMER ELDREDGE NIESZ, manager of industrial relations of the Commonwealth Edison Company and a pioneer

in the development of electric light and power in Chicago, died August 6, in his sixty-fourth year, following an operation for appendicitis. Mr. Niesz was born in Canton, Ohio, and was graduated from Mount Union College in 1866. Shortly after his graduation he came to Chicago and formed an immediate connection with the then infant industry of electricity supply. Starting in as a lineman of the old Chicago Edison Company, after two years of various work he was appointed assistant superintendent of construction, and in 1889 became assistant to the general manager. Other promotions followed, such as assistant to the vice-president in charge of construction, and in 1921 he was made manager of industrial relations. Mr. Niesz was a very active member of most of the business and technical organizations connected with the electric light and power industry. He had served as president of the National Safety Council, Western Society of Engineers, the Electric Club of Chicago and the Chicago Engineers' Club. He took a prominent part in the work of the Electric Association of Chicago and the American Institute of Electrical Engineers, the Illuminating Engineering Society, the Industrial Relations Association of America, and the National Electric Light Association.

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BRUCE FORD, inventor and engineer, who for many years was an outstanding figure in the storage battery field, died August 10, at his home in Philadelphia, after a brief illness. He was in his fifty-ninth year. Mr. Ford was second vice-president and a director of the Electric Storage Battery Company and until recently had been general manager. He had been connected with the company continuously since 1899. He had to his credit more than fifty patents on inventions in the storage battery field and was responsible for the design of many batteries used by the United States Government during the World War. Mr. Ford was a director of the Chloride Electrical Storage Company, Ltd., of Manchester, England. He was a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, Franklin Institute and the Engineers' Clubs of New York and Philadelphia.

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HENRY B. SLATER, 81, one of the founders of the American Institute of Electrical Engineers, died July 7 at Riverside, Cal. Mr. Slater was a mining engineer and inventor, having many inventions to his credit dealing chiefly with mining and the improvement of metallurgical processes. In 1880 he was engaged in electrometallurgy for the Providence Tool Company and in 1882 was employed by the Singer Manufacturing Company. He went to Leadville in 1888 and worked with a process for extracting zinc from low-grade ores in that district. Since 1902 he had been engaged in metallurgical investigation in California. He held patents for three improvements in electric generators and motors, one for extraction of zinc, and numerous other metallurgical inventions. He was particularly interested in the effect of chlorine upon minerals in ores. Mr. Slater was a member of the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Chemical Society.

Financial and Statistical News

THE sharp market upturn which followed news of the formal agreement putting into effect the moratorium on intergovernmental debts raised utility averages several points in the widest market advance in more than six weeks. While the rise in utility stocks was less marked than that of industrials, ELECTRICAL WORLD index of 37 stocks rose to 59.9, against 58.8 at the end of July.

——ALTHOUGH CLOSE TO THE January low, the ELECTRICAL WORLD index of industrial production for July shows a gradual approach to last year's level because of the downward trend in the first half of that year, against an upward movement in 1931.

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Output Gradually Gaining

OUTPUT OF PUBLIC utility plants in June, given by United States Geological Survey as 7,513,842,000 kw.-hr., was slightly less than in May, but the average daily production was 1.5 per cent greater than in the preceding month. Whereas the output in May was 5 per cent below that in 1930, in June it was down only 3 per cent, the smallest difference thus far this year. The total here given includes, among others, the production in electric railway plants and the output for public consumption of certain manufacturing plants as well as that of central stations for light and power.

Of the total output, 38 per cent came from water power; last year the corresponding ratio was 39 per cent. The Geological Survey points out that the production by the use of water power continues less than last year, indicating that the flow of power streams is still below normal, owing to the continuation of drought conditions.

New England's output is again 2 per cent ahead of last year's, as it was in May. The only other geographical region reporting a gain was the East South Central, 12 per cent, due to a sudden large increase in the output from water power.

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Canadian Commission to Buy Power from Five Companies

ACCORDING TO A SURVEY of prospectuses issued by the private companies concerned, the Hydro-Electric Power Commission of Ontario has contracts for the purchase of power from five producing corporations at an annual cost of approximately $9,500,000. The five companies are the Ontario Power Service Corporation, MacLaren-Quebec Power Company, Ottawa Valley Power Company, Gatineau Power Company and the Beauharnois Power Corporation.

In the case of the Ontario Power Service Corporation, the hydro contract is for 100,000 hp., delivery of which is to commence by October of next year. Net earnings from this contract are placed at $1,272,889. The contract with the MacLaren-Quebec Power Company is for 30 years, calls for delivery by July, 1933, and is for a total of 125,000 hp. Net earnings from the contract are placed at $1,484,000. In the case of the Ottawa Valley Power Company the Ontario contract is for 96,000 hp., with delivery to commence October 1 this year. The contract is to run for 40 years and annual earnings therefrom are figured at $1,017,000. Interest on outstanding bonds is said by the Gatineau Power Company to be just earned by its contracts with the Ontario commission, which are for 260,000, 60,000 and 20,000 hp., delivery having commenced in 1928. Finally, there is Hydro's contract with the Beauharnois Corporation, for 125,000 hp., with delivery scheduled to commence October 1, 1932. This contract is for 30 years and estimated revenue is placed at approximately $2,156,250.

The total receipts by the above companies, on the above basis, from the Ontario Hydro Commission are $9,477,239.

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Subsidiary Launched to Finance Expansion

PLANS for the future expansion of the utility industry are typified in the recent incorporation of a wholly owned subsidiary by the American Commonwealths Power Corporation. The function of this new unit, corporation officials stated this week, is to secure capital for the expansion of the entire system through the sale of its preferred stock. It is also named American Commonwealths Power Corporation and is a New Jersey corporation, while the parent is incorporated in Delaware.

The new organization, officials state, will carry on customer sales more or less continuously. It will sell its own prior preferred stock representing participation in the corporation's earnings and assets. It occupies a prior position also in respect to dividends which are cumulative and must be paid before dividends are paid on any other class of preferred or common stock. The new class of preferred will thus presumably be a readily marketable issue, its precedence to existing preferred issues being the reason, apparently, for the flotation of the new corporation.

Officers of the corporation state the new financial program provides that for each share of prior preferred stock of the new unit in the hands of the public the corporation will hold at least $200 in notes, bonds or debentures of the parent company or subsidiaries or in cash. The program also provides that the new corporation may not lend any of its funds at an interest rate lower than 6¼ per cent. The parent company, moreover, may not receive any of the subsidiary's earnings until after the full dividend of $6.24 per share has been paid on the new preferred stock.

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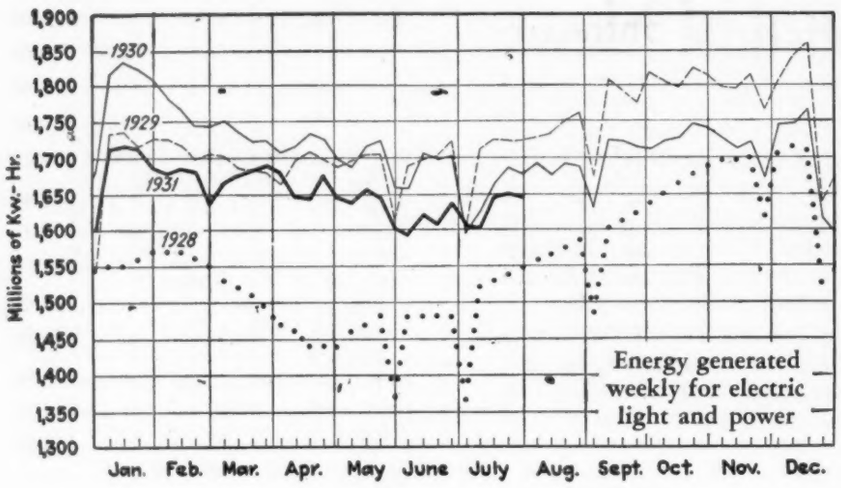
Tenney Banking House Is Formed

ANNOUNCEMENT HAS BEEN MADE by Charles H. Tenney, Rockwell C. Tenney and Matthew Lahti of the formation of Tenney & Company, Inc., to continue with the same personnel the investment banking business formerly conducted by the investment department of Charles H. Tenney & Company, Boston. Offices are being established at 200 Devonshire Street, Boston, in the building occupied by the Tenney company for some years past. The establishment of this independent banking house under the new name follows the merger of the public utility management interests of Colonel Tenney and associates with New England Power Association of Boston.



Output Trends Upward

As is usual at this time of year energy generated in central stations has been gradually and somewhat irregularly increasing during recent weeks, but it remains below the level of 1930 by about 2 per cent and below 1929 by 5 per cent. For the week ended August 8 the output compared with the corresponding week of 1930 shows a loss of 2.9 per cent.

Estimates for recent weeks, with corresponding figures for the three preceding years, as announced by the statistical research department of the National Electric Light Association, are as follows:

	1931	1930	1929	1928
July 11	1,604	1,626	1,712	1,521
July 18	1,645	1,667	1,727	1,530
July 25	1,651	1,686	1,723	1,539
August 1	1,644	1,678	1,725	1,549
August 8	1,643	1,692	1,730	1,558

The table incorporates revisions made to bring the weekly figures into agreement with the final monthly totals as previously reported.

The chart also has been redrawn to conform with the revisions for the entire period covered; in addition, it has been made to cover the complete years 1928, 1929 and 1930 instead of carrying the curves for those years only up to the week corresponding to the latest figures for 1931, as heretofore.

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New Capital Issues

During the week ended August 13 Electric Bond & Share Company issued 100,000 shares of cumulative $5 preferred stock at $89.75 a share and accrued dividends, to yield 5.57 per cent.

First mortgage gold bonds were offered by the New York State Electric & Gas Corporation to the amount of $7,000,000, the price being 99 and accrued interest. This 4½ per cent series matures in 1980. These first mortgage bonds have been previously issued and held by an affiliated company and do not represent new financing by the New York State Electric & Gas Corporation at the present time.

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NEWS BRIEFS

Stockholders of the Central Public Service Corporation increased at the rate of nearly 1,000 per month during the first six months of 1931. Holders of the corporation's securities on July 1 totaled 70,706.

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The Missouri State Public Service Commission has authorized the Union Electric Light & Power Company of Missouri to purchase the Union Electric Light & Power Company of Illinois. The deal will be perfected by the transfer to the Missouri company of the 375,000 shares of common stock of the Illinois corporation at $20 a share and in turn the Missouri company is authorized to sell 375,000 shares of its no-par value common stock to the North American Edison Company at $25 a share.

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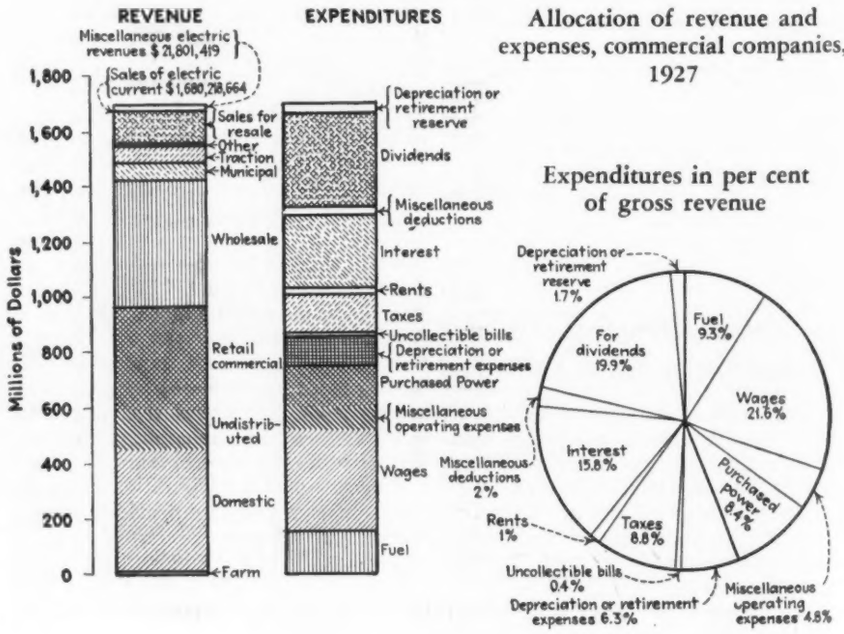
Wages the Largest Item

Wages constitute the largest single item of expense to the electric light and power companies in the United States. Fuel, the material from which two-thirds of the energy is produced, costs less than half as much as wages. Purchased energy, including that bought by companies not operating any generating equipment as well as that bought by generating companies from one another, approaches fuel in cost.

The huge investment necessary for the conduct of the industry results in the expenditure of nearly 36 per cent of the revenue to cover interest charges and dividends, although the latter item represents a rate of only 6.6 per cent, based on the total of $5,095,135,415 for capital stock.

The figures on which the accompanying charge are based are those of the 1927 Census of Electric Light and Power Companies and apply only to commercial establishments. Lack of some of the corresponding data relating to municipal establishments makes it impossible to include this group.

To represent operations in 1930 the total would have to be increased by approximately 20 per cent, but the ratios probably would not be greatly changed except in the case of taxes. This item is absorbing a constantly increasing share of the income.



Allocation of revenue and expenses, commercial companies, 1927

Industrial Activity Shows Contrasts

MIDSUMMER generally brings a slackening of industrial activity. This year is no exception. Compared with June the ELECTRICAL WORLD index for July shows a decline of 3.8 per cent; compared with May, of somewhat more than 10 per cent. The decline brings the summer minimum—or what will presumably be the minimum—almost down to the low point of last winter. That sounds doleful until examination of earlier records reveals the same situation in 1929, an actual decrease in 1926 and a much greater one (fully 10 per cent) in 1930.

The fact is that while operations have long been below the preceding year's level the index now is only 7 per cent less than it was at the corresponding time last year, whereas a few months ago the spread was 20 per cent.

The decline is due mainly to the influence of a few important groups. In the manufacture of automobiles, parts and accessories each month since March has shown a falling off. The decline itself is not abnormal, but the low starting point brings the index to its lowest value since December, 1926. During the year thus far it has usually been about 25 per cent lower than in 1930, the monthly fluctuations in the two years being roughly paralled. In July the difference was 26 per cent.

The manufacture of iron and steel, after an upward movement culminating in March, has receded each month; its index is down 4 per cent from June, 22 from May, 24 from July, 1930. Fairly similar have been the changes in the metal working industries, which are down 27 per cent from July, 1930. Their combined index is lowest since 1924.

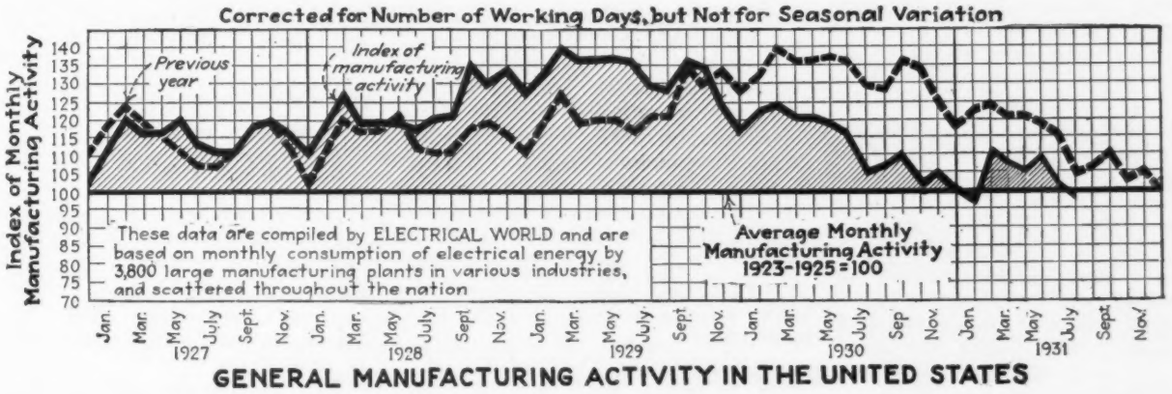
In contrast the manufacture of food products is at the highest point recorded, 1 per cent above last year's maximum. In textiles the July index is 35 per cent above the low point of last August; leather products continue well above winter and early spring levels.

Index of Manufacturing Activity

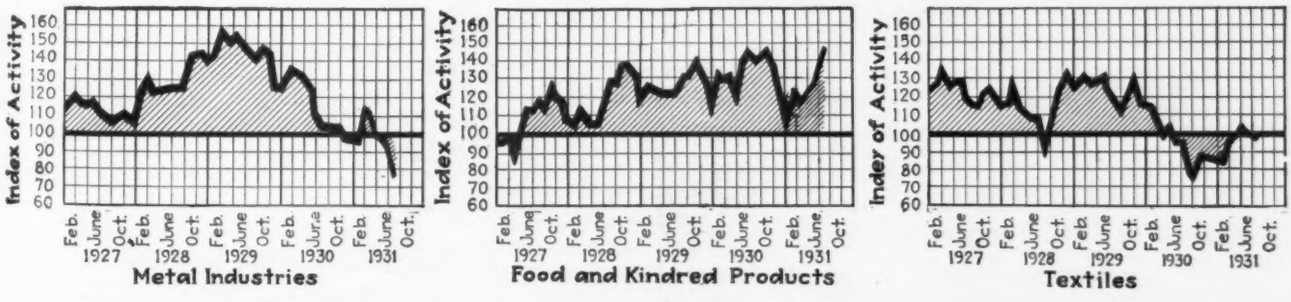
Base: Average Month 1923-25

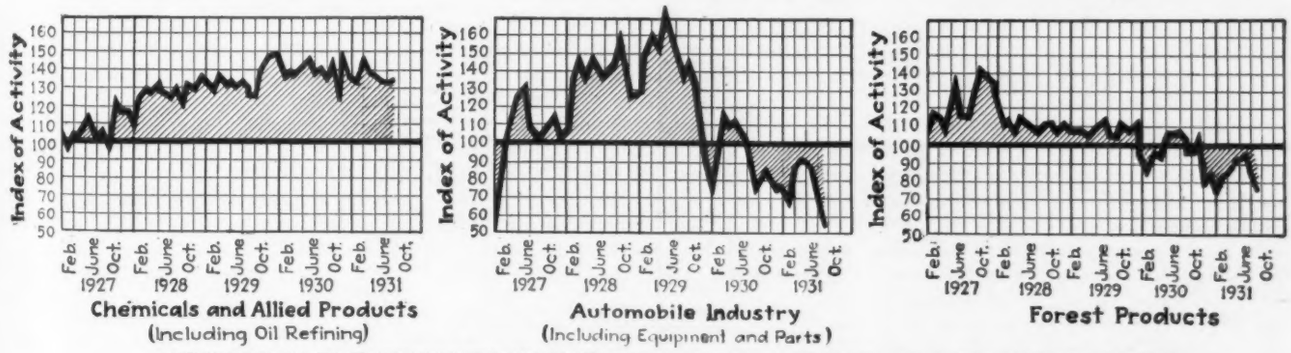
Industrial Group	July, 1931	June, 1931	May, 1931	April, 1931	July, 1930
All Industry	**97.9**	**101.7***	**109.8**	**106.4**	**105.1**
Automobiles (including parts and accessories)	55.9	71.3	89.7	90.8	75.3
Chemical products (including oil refining)	137.7	132.7	133.8	137.4	140.6
Food products	147.0	136.2	126.8	122.0	139.2
Iron and steel	83.1	86.6*	106.6	108.1	109.7
Metal working	69.3	78.6	94.0	94.6	95.1
Leather products	83.8	85.4	81.0	83.9	97.3
Forest products	76.9	86.3	97.2	91.5	100.0
Paper and pulp	104.0	112.4	135.1	109.6	119.9
Rubber products	97.4	121.0	122.3	109.0	103.8
Shipbuilding	82.0	84.8	89.7	92.5	116.8
Stone, clay and glass	104.8	118.7	132.0	116.5	110.8
Textiles	98.2	100.5	103.7	100.0	79.7

*Revision.


Corrected for Number of Working Days, but Not for Seasonal Variation
Index of Monthly Manufacturing Activity
Previous year
Index of manufacturing activity
These data are compiled by ELECTRICAL WORLD and are based on monthly consumption of electrical energy by 3,800 large manufacturing plants in various industries, and scattered throughout the nation
Average Monthly Manufacturing Activity 1923-1925=100
1927
1928
1929
1930
1931

GENERAL MANUFACTURING ACTIVITY IN THE UNITED STATES





ACTIVITY IN THE PRIMARY MANUFACTURING INDUSTRIES OF THE UNITED STATES

Business News and Markets

Electrical Telegraph Code Ready Shortly

THE FIRST COMPLETE industry telegraph code, preparation of which was announced in an earlier issue, has been attained in the electrical field. A joint industry committee made up of seven major associations has been at work for over a year compiling and arranging for the publication of LCODE, "a telegraph code book of standard five-letter combinations for the electrical industry, including all works and phrases commonly used in the purchase and sale of electrical equipment and supplies."

Under N.E.M.A. sponsorship, the following groups have united in the production of this pioneer effort: Association of Electragists, International, National Electric Light Association, National Electric Wholesalers' Association, Radio Manufacturers' Association, Radio Wholesalers' Association and the Society for Electrical Development.

The new code will go into effect within six weeks from publication (November 1). At that time a list will be issued to every holder advising him of all other holders. This list will be kept up to date from time to time.

The book of 288 pages, $7\frac{3}{4}$x$10\frac{5}{8}$, is bound in semi-flexible fabricoid and will contain over 50,000 words allotted to general business phrases and technical terms. A complete tabular section will cover calendar, numerals, motor ratings, symbols, etc. Each copy carries a pocket for the cumulative list of holders. The list price is $6.50

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Acme Card System Record Forms Announced

ELECTRIC UTILITY EXECUTIVES in charge of auditing, accounting, purchasing, stock and property records are invited to write to the Acme Card System Company, 8 South Michigan Avenue, Chicago, Ill., for a copy of its recently issued collection of typical record forms in use by public utilities. This book contains facsimiles of forms used by 104 different central stations and supplied by the Acme company. Out of a library of 17,000 forms these 104 samples were selected as representative of those especially applicable to the utility field. For comparison with the practices of other central stations looking toward improvement of local methods the book has distinct value. It is handsomely bound in imitation leather. Each copy is registered and sent to any utility executive without charge.

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Underground Conduit for Electrification

ORDERS FOR APPROXIMATELY 300 miles of underground clay conduit for housing signal and communication cables involved in the electrification of the Pennsylvania Railroad lines between New York and Washington have just been received by the National Fireproofing Corporation. This notable undertaking has just been broadened to extend from Wilmington, Del., on to Washington, D. C., with indications that the work will be pushed rapidly to completion.

Production and shipping of the conduit has already commenced and will put a great many additional men to work in both the manufacture and installation of this material.

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Half-Year Business Sharply Curtailed

WHAT effect the business depression has had and is having upon the electrical manufacturers is seen in a miscellaneous group of reports for the first half of 1931.

Half-year statements of the larger companies, already published, show a sharp curtailment of business. Net sales billed by General Electric Company in the six-month period were $141,180,091, against $197,229,346, a drop of 28.5 per cent. For the same period Westinghouse reported sales billed of $60,623,333, against $93,222,036, a drop of 34.9 per cent.

A miscellaneous group of reports issued within the last week or two show a similar falling off in business.

Maytag Company had net sales for the half year of $5,479,345, against $9,073,504 for the first half of 1930, a 39.6 per cent drop.

Electric Auto-Lite Company and subsidiaries had net profits for the period, after all charges, of $2,769,865, against $3,733,729, a decline of 25.8 per cent.

Electric Controller & Manufacturing Company had net income for the period of $46,317 after all charges, against $342,914.

Eureka Vacuum Cleaner had a net loss after charges of $313,582, against a net loss of $184,948 for the first half of 1930.

Syracuse Washing Machine Corporation showed net profit for the period of $221,141, against $95,984 for the 1930 period.

Yale & Towne Manufacturing Company showed a net loss of $104,914, against a net profit of $154,562 for the half year.

Earnings of the Timken Roller Bearing Company for the half year were $2,462,714, against $6,120,023 for the first half of 1930, Timken reduced its dividend rate on common from $3 to $2 as a result.

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Largest Welded Steel Condenser

WHAT IS STATED to be the largest welded steel condenser ever manufactured is now being built by the Westinghouse Electric & Manufacturing Company at its South Philadelphia Works for the Public Service Electric & Gas Company of New Jersey.

This is a 65,000-sq.ft. condenser of the single-pass, radial-flow, welded-steel-plate construction and will serve a 75,000-kw, single-cylinder Westinghouse turbo-generating unit. It marks a decided departure in condenser manufacturing, utilizing the principle of welding in a new field.

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Radio Net Income Rises Sharply

TOTAL GROSS INCOME of $47,973,727 and net income of $2,638,703 for the Radio Corporation of America and its subsidiaries for the first six months of the year 1931 were announced by David Sarnoff, president of the corporation. During the same period last year the gross income was $52,732,079 and the net income $505,098.

The statement for the first six months of 1931 showed earnings of $35,294 in excess of dividend requirements on the preferred stocks. Preferred stock dividends totaled $2,603,409.

British Electrical Manufacturers More Active

THE BRITISH ELECTRICAL export trade is in low water at present, reflecting the position in orders received seven or eight month ago—the height of the slump. Total exports of electrical equipment were $26,235,000 during the first five months of 1930, whereas in the first five months of 1931 they dropped to $17,950,000. The corresponding fall in electrical machinery over the same period was from $13,975,000 to $9,550,000. But here again there seem to be signs that the decrease from month to month is gradually becoming less marked, and it is probable that within three or four months it will be averted.

Statistics indicate that the electrical manufacturing industry of Britain has not suffered to anything like the extent of the corresponding industry in either the United States or Germany. Moreover, the domestic demand for electrical apparatus has not declined to the same extent as the corresponding demand in either of the other countries. The generation of current in the United Kingdom during the year so far has shown an important increase on the corresponding period of 1930.

In connection with the export position in the countries mentioned, an important factor must be remembered: It is only quite recently that the German electrical export returns have begun to show a decline, and it is widely known that the German industry has been dependent upon exports due to the severely depressed conditions at home. The export of German apparatus at low prices has been a very large factor in the recent dislocation of the electrical markets of the world. The Hoover plan should be instrumental in stimulating domestic demand.

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New York Metal Prices

	Aug. 5, 1931 Cents per Pound	Aug. 12, 1931 Cents per Pound
Copper, electrolytic	7½	7½
Lead, Am. S. & R. price	4.40	4.40
Antimony	6.65	6.60
Nickel, ingot	35	35
Zinc, spot	4.20	4.20
Tin, Straits	24.40	26
Aluminum, 99 per cent.	23.30	23.30

TRADE BRIEFS

Walter Ferry, for the past ten years identified with the radio and electrical appliance business in Newark and New York, resigned his position as divisional sales manager of the Westinghouse Electrical Supply Company, Newark, recently to enter business for himself under the title of the Electrical and Radio Distributing Corporation at 113 Orchard Street and 9 Elder Place, adjacent to the Industrial Office Building, Newark.

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Ellsworth L. Mills, formerly sales manager for the Bastian-Blessing Company, maker of welding equipment (torches, regulators, generators, etc.) has been elected vice-president of the company. Mr. Mills continues in charge of sales.

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Directors of the Acme Wire Company, New Haven, Conn., have voted to defer action on the quarterly dividend ordinarily payable at this time on the common stock. The last quarterly payment of 25 cents per share was made on this issue March 14, 1931.

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EXPORTS OF ELECTRICAL EQUIPMENT (PRELIMINARY)

Article	June 1930	June 1931
Generators:		
Direct-current—		
Under 500 kw	$74,063	$40,204
500 kw. and over	4,684	68,738
Alternating current—		
Under 2,000 kva	22,582	8,135
2,000 kva. and over	.....	.....
Steam turbine generator sets	69,794	9,575
Accessories and parts for generators	55,067	131,373
Arc welding sets	35,863	41,881
Self-contained lighting outfits	73,900	21,259
Batteries:		
6-volt storage batteries	147,341	122,330
Other storage batteries	63,379	50,286
No. 6 dry cell batteries	54,498	32,695
Flashlight batteries	219,961	145,037
Radio B and C batteries (dry)	48,649	28,541
Other dry- and wet-cell primary batteries	16,939	8,037
Transforming or converting apparatus:		
Power transformers, 500 kva. and over	134,207	12,557
Distribution transformers, less than 500 kva	220,959	24,719
Instrument transformers	15,577	45,137
Other transformers	153,944	54,395
Complete battery chargers under 15 amp	15,935	3,733
Double current and motor generators and other converters	64,135	90,839
Transmission and distribution apparatus:		
Switchboard panels, except telephone	154,400	69,127
Power switches and circuit breakers over 10 amp.	225,503	469,696
Fuses	26,344	22,979
Watt-hour and other measuring meters	53,685	47,122
Electrical indicating instruments	69,883	48,939
Electrical recording instruments	33,026	24,422
Other electrical testing apparatus	70,269	43,939
Lightning arresters, choke coils, reactors and parts	139,204	52,442
Motors, starters, and controllers:		
Motors, ¼ hp. and under	189,929	120,706
Motors, over ¼ and under 1 hp	65,732	33,070
Stationary motors—		
1 to 200 hp	$293,065	$166,385
Over 200 hp	87,301	33,461
Railway motors	21,316	21,049
Electric locomotives—		
Railway	7,702	100,507
Mining and industrial	59,515	126,867
Station and warehouse electric motor trucks	52,662	38,168
Starting and controlling equipment—		
For industrial motors	143,477	77,105
For electric railway and vehicle motors	19,116	6,780
Portable electric tools	75,991	142,657
Accessories and parts for motors	157,799	178,057
Electric refrigerators and parts:		
Household	1,044,160	724,202
Commercial up to 1 ton	249,365	209,145
Parts for electric refrigerators	.....	283,429
Electric appliances:		
Electric fans	106,927	51,698
Electromechanical health exercisers	9,793	1,694
Electric incandescent light bulbs—		
For automobiles, flashlights and Christmas trees	15,266	20,375
Other metal filament	89,299	45,060
Other electric lamp bulbs	17,682	3,455
Flashlight cases	118,189	44,138
Searchlights and floodlights	37,099	34,545
Electric household washing machines	155,068	68,743
Electric domestic vacuum cleaners	173,478	84,296
Other domestic motor-driven devices, except tools	56,031	41,930
Electric flatirons	22,287	21,016
Electric cooking ranges	8,940	84,900
Other domestic heating and cooking devices	65,105	40,667
Industrial electric furnaces, ovens, and other heating devices	157,685	108,343
Therapeutic and X-ray apparatus	88,632	108,101
Signal and communication devices:		
Radio apparatus—		
Transmitting sets, tubes, and parts	71,738	88,587
Receiving sets	584,571	954,517
Radio receiving tubes	$165,063	$187,720
Receiving-set components	301,837	236,216
Loudspeakers	169,927	79,967
Other receiving-set accessories	73,823	34,133
Telegraph apparatus	55,408	29,694
Telephone apparatus—		
Telephone instruments	45,172	45,870
Telephone switchboards	181,042	24,634
Other telephone equipment	258,767	114,789
Bells, buzzers annunciators and alarms	23,330	44,672
Other electric apparatus:		
Spark plugs	106,446	135,807
Other starting, lighting, and ignition equipment	101,804	63,854
Insulating material	76,710	45,638
Metal conduit, outlet and switch boxes	99,992	53,643
Sockets, outlets, fuse blocks, and lighting switches	136,316	131,389
Electric interior lighting fixtures	146,621	91,508
Electric street lighting fixtures	72,131	13,204
Other wiring supplies and line material	149,146	102,522
Other electrical apparatus, n.e.s	954,604	377,082
Rubber and friction tape	28,445	25,796
Globes and shades for lighting fixtures	55,948	34,549
Glass electric insulators	18,151	14,947
Electrical porcelain:		
For less than 6,600 volts	42,261	36,348
For 6,600 volts and over	54,517	155,608
Carbons and electrodes:		
Electrodes for electric furnaces	188,993	88,447
Other carbon products	64,273	40,517
Insulated iron or steel wire and cable	9,505	8,616
Copper, bare wire	243,334	41,535
Insulated copper wire and cable:		
Rubber-covered wire	94,509	22,952
Weatherproof wire	31,587	23,536
Telephone cable	8,452	21,344
Other insulated copper wire	306,359	159,361
Nickel-chrome electric resistance wire	.....	10,153
Totals	$10,774,204	$8,277,861
Six months ended June 30.	$71,573,219	$60,494,396

Market Conditions

EARLY fall business begins to look more promising in the Eastern district. Substation business is still among the most important, but railway electrification orders bulk large this week. Electrical business in the South is still on a hand-to-mouth basis, with buying only for immediate necessity.

——CONSTRUCTION HAS TURNED UPWARD on the Pacific Coast after a sharp decline in July, but prices still tend downward. Lumber mills in the North are beginning to resume activities.

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EASTERN

—CENTRAL-STATION ACCOUNT *is developing better proportions in the Eastern district and, with inquiries showing an increasing volume, early fall business begins to look more promising. Transformers and other substation apparatus continue to form the bulk of demand.*

—ADDITIONAL CONTRACTS *for railway electrification work, representing a gross of several million dollars, are a feature of the week's market, closely seconded by a substation project, for which steam line electrification is directly responsible, to cost ultimately more than $2,500,000. While industrial business holds on a restricted level, there is noticeable improvement in motor demand from that quarter with indications for continuance.*

The Philadelphia Electric Company will proceed with the construction of a new frequency changer substation to cost over $1,000,000, and to represent an investment of about $2,750,000 when entirely completed. The unit will be used for power supply for the electrified lines of the Pennsylvania Railroad. Contract has been placed with the General Electric Company for primary equipment for the plant, consisting of two 30,000-kw. frequency changers with accessory apparatus: four additional such units will be added at a later date. The Pennsylvania company has authorized the installation of an underground conduit system from Wilmington, Del., to Baltimore, Md., and thence to Washington D. C., in connection with its electrification program, estimated to cost close to $7,000,000; it is scheduled for completion early next year and will comprise about 11,000 miles of underground wires. The railroad has ordered a quantity of structural steel from three fabricators for different features of the overhead catenary system for feeder lines. An order for 100 carloads of clay conduit has been given to the National Fire Proofing Company, which it will handle at its Brazil, Ind., plant, while another order for similar conduit sections has been given to the Brazil Hollow Brick & Tile Company, likewise of Brazil, aggregating 50 carloads. The Timken Roller Bearing Company, Toledo, Ohio, has secured an award for bearings for new electric locomotives for the railroad, now being built by the General Electric and Westinghouse companies, aggregating $400,000, and representing the largest contract ever placed for anti-friction bearings for locomotive service.

A New York manufacturer has secured an order for transformers and accessory apparatus from a metropolitan power station, totaling $85,000. The Otter Tail Power Company has contracted with Westinghouse Electric & Manufacturing Company for a 7,500-kw. turbo-generator unit, for installation at one of its stations now being extended. Westinghouse company has taken an order for four 6,000-kva. transformers and auxiliaries for a municipal power installation at Hamilton, Ohio, totaling $39,092, the order for switchboard, voltage regulator and miscellaneous kindred equipment going to General Electric Company at a price of $47,574.

CONSTRUCTION PROJECTS

New York Central Railroad Company, New York, has plans for a freight terminal and yard at Syracuse, N. Y., to cost $500,000. Tide Water Oil Company, New York, has plans for additional units at oil plant at Bayonne, N. J., to cost $175,000. United Engineering Company, New York, contemplates paper book match manufacturing plant in vicinity of Havana, Cuba, to cost over $300,000. New Jersey Power & Light Company, Dover, N. J., will make extensions and improvements in street-lighting system at High Bridge, N. J. Herman L. Hohlfeld, Franklin Trust Building, Philadelphia, Pa., real estate, is at head of project to build a 40-story hotel at Atlantic City, N. J., to cost close to $10,000,000. Department of City Transit, Philadelphia, Pa., will receive bids until August 25 for automatic signaling and interlocking equipment for Ridge Avenue subway. Hershey Industrial School, Hershey, Pa., plans additions to cost over $1,000,000. West Penn Power Company, Pittsburgh, Pa., plans transmission line over Allegheny River, near Parker, Pa.

SOUTHWEST

—POWER COMPANIES *still hesitate to break into their budgets, buying only where it is clearly necessary. However, there has been a slightly greater volume of distribution transformers and meters shipped during the past week than previously.*

The large cotton crop in Arkansas will demand attention within a month and gins are being put in shape to handle the production. The only contract reported is for a bank of transformers for an Arkansas distributing company to cost $12,000.

CONSTRUCTION PROJECTS

Kansas Power Company, Topeka, Kan., has approved plans for steam-operated electric power plant at Dodge City, Kan., to cost over $200,000. Cimarron Utilities Company, Guymon, Okla., plans transmission line to Optima, Okla., and vicinity, to cost about $25,000. Atchison, Topeka & Santa Fe Railway Company, Chicago, Ill., plans passenger and express station at Oklahoma City, Okla., to cost $500,000. Southern Advance Bag & Paper Company, Hodge, La., will carry out expansion program to double capacity of paper mill, reported to cost over $400,000.

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SOUTHEAST

—THE VOLUME *of orders for electrical equipment and materials last week was maintained at the level reported for some weeks past. Little new equipment is being purchased.*

—NORMAL SEASONAL SHUT-DOWN *of textile mills in this territory amounted to about 75 per cent of what it was in 1930 and the kilowatt-hour sales of utilities in the territory indicate that industry activity is about 5 per cent ahead of what it was in July, 1930.*

A Georgia power company ordered last week $5,200 worth of creosoted pine poles and crossarms and there is in more or less immediate prospect an order for $4,000 worth of disconnect switches, three 250-kva. transformers and $1,500 worth of lightning arresters in the same state. The federal penitentiary placed another order for $5,000 worth of supply lines and there is in prospect a motor order amounting to $5,000 from a South Carolina textile plant. Contracts were let last week on an airport in Louisiana, which contract approximates $50,000, and an airport out of this territory which will call for in excess of $10,000 for power cable.

CONSTRUCTION PROJECTS

Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until August 18 for a frequency

converter for navy yard at Norfolk, Va. (Schedule 6312). Tennessee Power Company, Chattanooga, Tenn., will build transmission line from Russellville to Springfield, Tenn., with power substation facilities. United States Engineer Office, Mobile, Ala., will receive bids until August 31 for an electric generating plant with direct-connected Diesel engine units (Circular 31). Georgia Power Company, Atlanta, Ga., will make extensions in power substation at Louisville, Ga., including equipment installation. Florida Power Company, St. Petersburg, Fla., plans power substation in vicinity of Inverness, Fla., to cost over $90,000.

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MIDDLE WEST

—GENERAL BUSINESS *in the Middle West section continues to drift along toward what promises to be the close of a dull and uneventful month. Summer inertia or lack of initiative is being felt in all lines.*

—MAJOR INDUSTRIES *are proceeding at a reduced rate, with shut-downs in the automotive field occurring and a further reduction of steel output scheduled. Carloadings have declined and retail trade has fallen off to a considerable extent.*

Unemployment has increased. State governmental bodies are preparing for a larger relief fund this winter than last. The various utility companies are proceeding conservatively and hand-to-mouth buying is still very much in vogue. Construction schedules are being maintained and every effort to continue normally is being made. Building requirements are being anticipated and equipment and apparatus are being placed as quickly as feasible. Some of the interesting orders placed this week include one for the construction of a 66-kv. building and superstructure of a 12-kv. building to cost approximately $500,000, water-cooled furnace floor materials, $17,000; six 200-kva., single-phase, pole-type distribution transformers, three 500-kva. and three 667-kva., single-phase, oil-insulated, water-cooled, 12,000-volt outdoor type transformers.

CONSTRUCTION PROJECTS

Ford Motor Company, Dearborn, Mich., has approved plans for assembling plant at Mexico City, Mexico, to cost over $1,000,000. Commonwealth Edison Company, Chicago, Ill., has filed plans for multi-story addition to power substation to cost over $500,000. University of Illinois, Chicago, Ill., plans new multi-story medical building to cost $1,500,000. Patterson Foundry & Machine Company, East Liverpool, Ohio, plans power plant for industrial service to cost $75,000, including generator and auxiliaries. Kroger Grocery & Baking Company, Cincinnati, Ohio, plans addition to cost over $100,000. Goerlich's, Inc., Toledo, Ohio, plans plant for manufacture of automobile equipment to cost 150,000.

PACIFIC COAST

—ALTHOUGH JULY BUILDING *construction in 25 leading California cities declined 50 per cent over July of last year, there is a slight upward trend now noticeable, especially in contracting material, which may be partially due to the return of jobber salesmen from vacation. Prices are still slipping, additional staple lines being added to those subject to lower prices.*

—RAILROAD EARNINGS *have slumped over $1,000,000 a month, and much projected work, such as extra telegraph lines for double tracking and several repeater systems for southern Oregon and northern California, have been indefinitely postponed as a result. Power company business, on the contrary, is slightly more encouraging.*

Residential work looms especially high in the building permits and there is an increasing proportion of hospitals, theaters, schools, and especially church jobs, with the United Artists Theaters erecting theaters at Vallejo, Richmond, Long Beach and Berkeley, averaging $80,000. Turlock will shortly be in the market for several 1,000-kva. transformers for the new irrigation substation and southern California for subway transformers. Other encouraging items cover a $1,250,000 federal building for Portland, request for bids for the $2,000,000 Sunnyvale dirigible base and the reported location of a $1,000,000 steel plant in the upper San Francisco bay territory.

Although there is a slight resumption of activities among lumber mills in the Puget Sound district sales of motors to these sources remain light, although last week inquiries in fair number, which may culminate in early purchases, were reported. Motor movements reported by larger jobbers include about 70 machines, ranging from 100 hp. down, the majority 25 hp. and under, to mills, allied woodworking plants and miscellaneous industrials. A few distribution transformers were purchased by the city of Seattle and Puget Sound Power & Light Company, and sales of miscellaneous switchgear approximating $3,000 were announced. On September 11, the city of Seattle will offer for sale $4,000,000 worth of light and power bonds, the proceeds to be used in substation and distribution line.

The Bureau of Reclamation at Denver on September 11 opened bids for apparatus for the Prosser power plant and Kennewick Highland pumping plant in eastern Washington, apparatus including one 4,200-hp. vertical hydraulic turbine, one 3,000-kva. alternating-current generator with direct-connected exciter and thrust bearing, one 3,000-kva., three-phase disconnecting switch, two 69,000-volt lightning arresters, two 69,000-volt airbrake switches, one power plant and one pumping plant switchboard and auxiliary apparatus.

CONSTRUCTION PROJECTS

Fields Chemical Company, Los Angeles, Calif., contemplates plant at Long Beach, Calif., to cost over $100,000. San Diego, Calif., plans ornamental lighting system using pressed steel standards. Crown-Willamette Paper Company, San Francisco, Calif., has plans for a mill at Los Angeles, Calif., to cost $300,000. Nazareth School for Boys, North Hollywood, Calif., plans five additions to institution to cost over $250,000. University of Washington, Seattle, has plans for an oceanographic laboratory to cost about $150,000. Bureau of Reclamation, Denver, Colo., will receive bids until September 11 for one 4,200-hp. vertical hydraulic turbine, one 3,000-kva. generator, with exciter, etc., transformers, switchboards, instruments, etc., for power plant at Prosser, Wash., for Yakima project, as per specifications.

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NEW ENGLAND

—SALES OF ELECTRICAL *equipment during the past week involved a steady demand for small motors and, according to one manufacturer, a slight increase in the sales volume over the preceding week. Orders for heavy equipment were few, though one 250-hp. paper drive was placed, together with switch and control apparatus.*

—SALES OF AUTOMATIC *throwover switches for hospital feeder service have been buoyant recently, according to one manufacturer.*

Marine electrical equipment orders continue to show encouraging trends and proposals for new installations for proposed government destroyers are being considered. Central-station sales are spotty, but one representative reports recent orders for control equipment amounting to over $2,500, and inquiries for small-lot apparatus orders. Electric wiring contracts for interior illumination on a considerable scale will soon be let and recently one amounting to about $39,000 was placed. Appliance sales in northeastern New England are holding up well, one company reporting $18,000 for one week's sales volume. Another notes sales of 54 electric ranges and 116 electric cookers. New construction includes Boston schools, $1,450,000, and Newton Hall, $650,000.

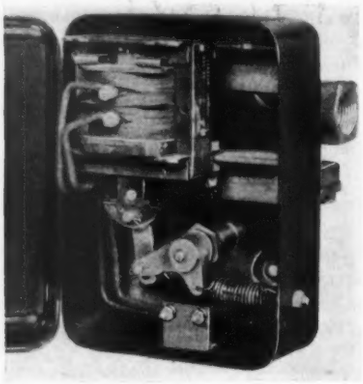
CONSTRUCTION PROJECTS

Rhines Hotel Company, Portland, Me., plans experimental television radio station to cost about $200,000. Lowell Electric Light Company, Lowell, Mass., plans equipment service, storage and distributing plant to cost $125,000. Palmer Steel Company, Springfield, Mass., plans addition to plant at Willimansett, Mass., to cost close to $90,000.

New Equipment Available

Solenoid-Operated Valve for Liquids

A SOLENOID-OPERATED VALVE, designated CR-9507-A1, for controlling liquids and gases under pressure has been announced by the General Electric Company. Some of the uses for which the valve is designed are for operating steam or air whistles, for controlling the flow of brine through cooling pipes in cold-storage rooms, for remotely or automatically controlling the supply of



oil or gas to furnaces, etc. The valve body is made of high-grade castings in two sections with the upper section fastened to the lower by bolts.

Some of the advantages claimed for this device are: Operating coils are designed for continuous duty, valves are of the unbalanced type and require little power for operation, minimum number of wearing parts, solenoids and operating mechanisms are inclosed in sheet-metal cases with knockouts suitable for conduit connection, etc.

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Ventilated Type Speed Regulators

A LINE OF SPEED REGULATORS designed for use with constant and variable torque a.c. and d.c. fractional-horsepower motors has been announced by the Ward Leonard Electric Company, Mount Vernon, N. Y. These regulators can be furnished for use with series-wound a.c. motors. When so used the rheostat usually has no "off" point or the full-speed position is located next to the "off" point to assure full torque at starting. These regulators are furnished with a molded knob designed to indicate the position of the contact arm.

They are built to conform with N.E.M.A. classification numbers 93 and 95 and are listed as standard apparatus by the Underwriters' Laboratories. The Underwriters' listing is given under "Industrial Control Equipment, Motor Controllers, Manual" as No. 1101. This number appears as the first four digits of the identifying number of the name-plate.

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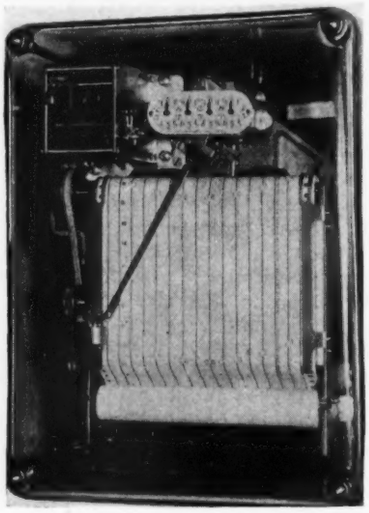
Recording Demand Watt-Hour Meters

A NEW RECORDING demand watt-hour meter, designated type RB, is announced by the Westinghouse Electric & Manufacturing Company. It indicates on a four-counter dial the total kilowatt-hours consumed and records on a chart the integrated demand in kilowatts over successive predetermined intervals.

This meter consists of a watt-hour meter register containing gears for driving the four integrating counters, causing the pen to advance across the charts a distance proportional to the kilowatt-hours consumed during the interval for which the meter is set. At the end of the interval the pen is automatically released from the driving mechanism and swings back to the zero position, where it is again meshed with the gear train, ready to advance during the next interval.

A small synchronous motor serves to

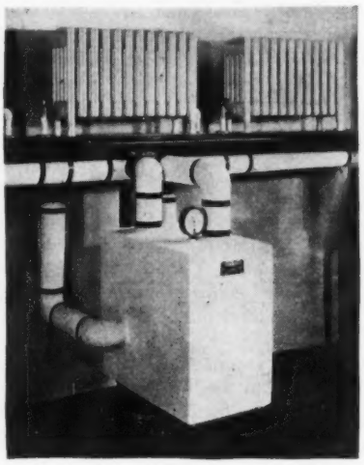


determine the time intervals and also to furnish power for advancing the charts. During the time interval the motor stores energy in a spring, which at the end of the time interval is released, advancing the chart and resetting the pen to zero.

Furnace Has Electrically Welded Boiler

A NEW ELECTRIC FURNACE in which the boiler section is a tank made of sheet steel with electrically welded seams is announced by the Home Electric Furnace Heating Company, New Haven, Conn. The basic principle of this new furnace, which is called "Furnelect," lies in the construction of the heat chamber and the type of metal used, and therefore the efficiency with which the heat transfer takes place.

The heat chamber is a smaller tank placed within the main section. Numerous points projecting from the walls of



the heat chamber are so located as to absorb a maximum of heat from the heating units and conducted to the water in the boiler. The heating unit is made of "Nichrome" resistance wire, No. 4 gage, wound on special porcelain mountings; it is rated at 3,000 watts and can be connected up for either 220 or 110 volts. For control and replacement reasons the unit is purposely made up of six smaller units, all bolted on a base of refractory material, which in turn is inserted in the heat chamber.

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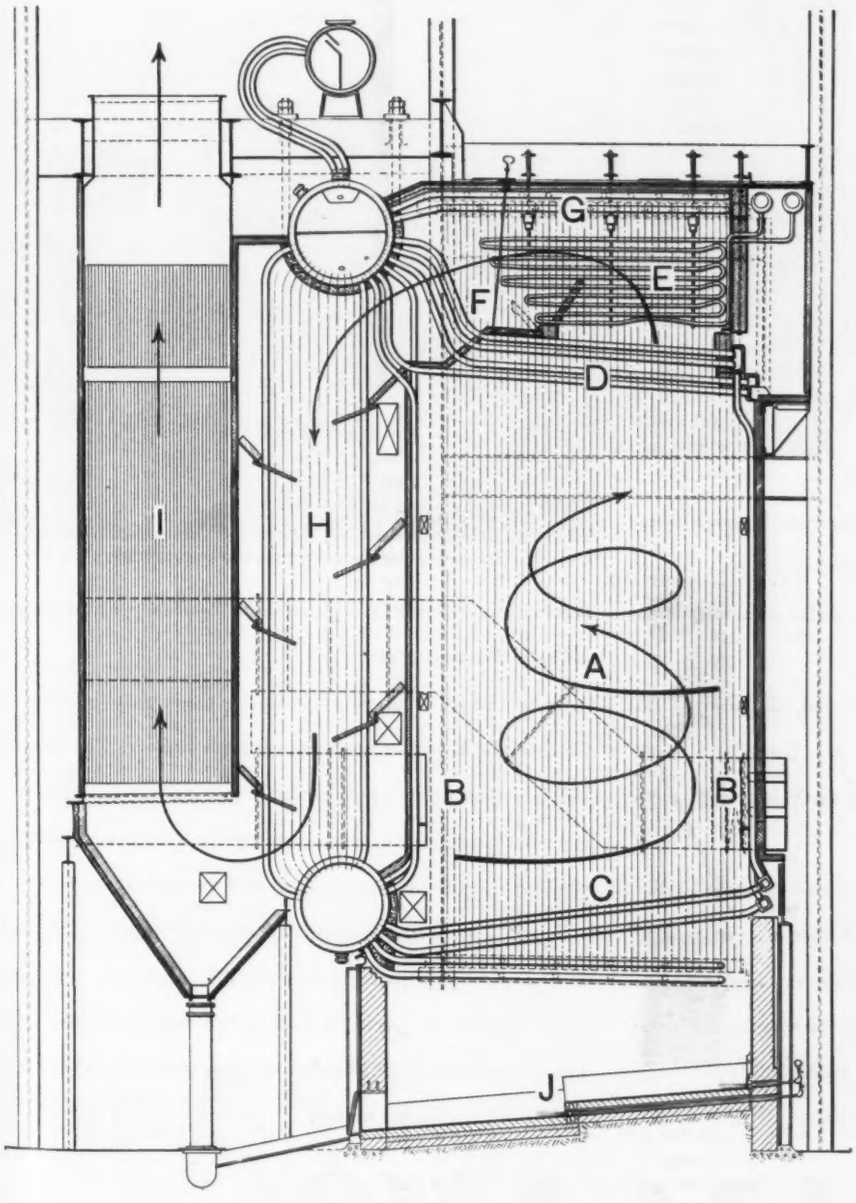
Range Surface Units for All Makes

A NEW UNIT for which are claimed the advantages of speed, efficiency, safety, long life and ease of installation is announced by the Edwin L. Wiegand Company of Pittsburg, Pa., under the name of "Chromalox Super-Speed." It has a smooth, flat top with chromium alloy heating surface and is fully inclosed. This new unit is made in 1,000, 1,200, 1,500 and 2,000 watts capacity. With a wide variety of unit castings available the "Chromalox" super-speed replacement unit can be supplied on short notice to fit openings of any other make or range.

The Combustion Steam Generator

The Combustion Steam Generator is built in eight standard sizes, providing capacities from 75,000 to 400,000 lb. of steam per hour, at any desired steam pressure and temperature. Designs covering units of larger capacity have been developed and will be submitted upon application. A catalogue fully describing the details of construction and operation of the Combustion Steam Generator is now available and will be sent upon request.



A - Brickless furnace...bare-tube furnace walls...no external risers or downcomers

B - Fuel and air inlets for corner firing

C - Ash pit "water screen"

D - Superheater screen

E - Superheater

F - Bypass damper for regulating temperature of superheated steam

G - Roof tubes

H - Convection bank

I - Plate air preheater

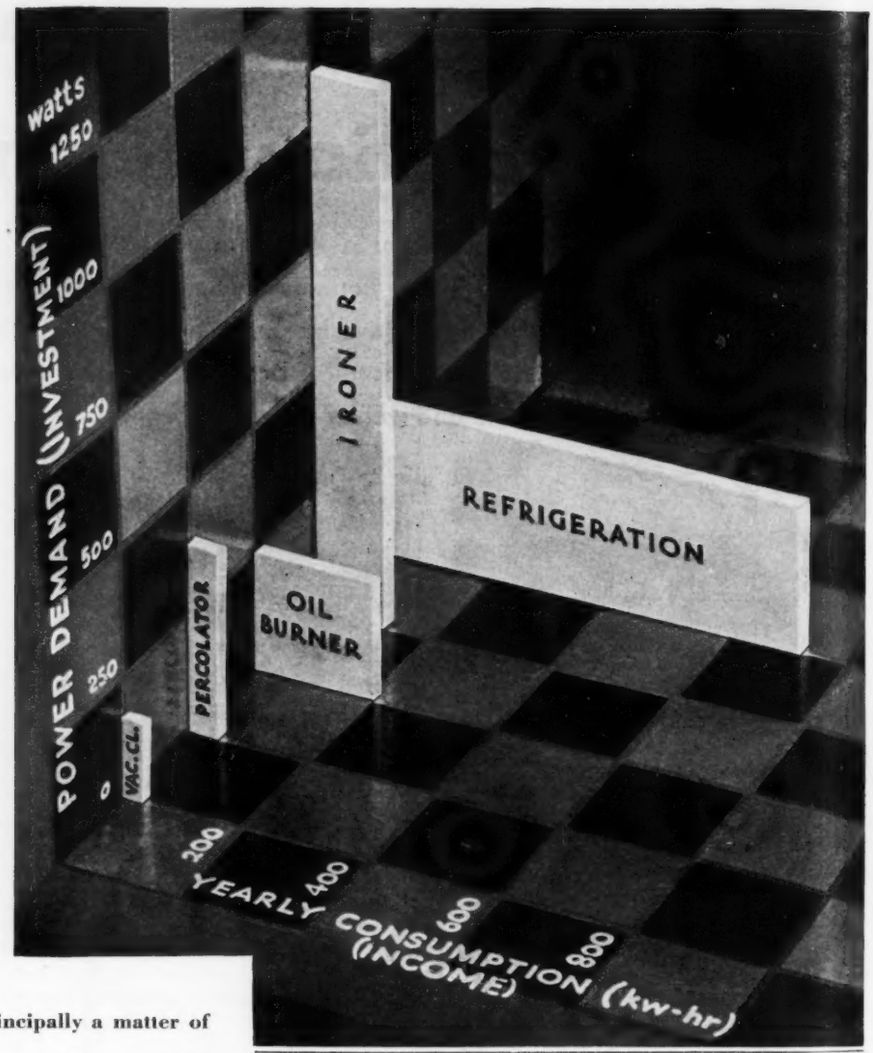
J - Sluicing ash discharge and conveyor

COMBUSTION ENGINEERING CORPORATION

200 Madison Ave., New York

BOILERS - AIR PREHEATERS - STOKERS - PULVERIZED FUEL EQUIPMENT - WATER-COOLED FURNACES

BUILDING LOAD *with appliances*



Increasing the load-per-customer is principally a matter of increasing the use of appliances. Those appliances which have low demand and long hours of use (high consumption) are the favored ones.

However, no matter which ones are used, the daily load curves of the individual installations are bound to have peaks characterized by wide variations in value and occasionally low power-factor.

Sangamo has anticipated the needs of the Electric Utility by providing meters for studying load characteristics and measuring special services. Among the meters available are Kw. and Kva. Demand Meters, Two-rate Meters for differentiating between peak and off-peak load. Last of all is the curve drawing Kva. Meter which gives a correct picture of any service load including power-factor, load-factor and demand, both in Kw. and Kva.

Once a more-load-per-customer campaign is adopted, the first step is the use of modern watthour meters. The Sangamo HC is the more-load-per-customer meter. It is supplied in all types of Sangamo alternating-current Watthour Meters, including singlephase, polyphase, and two-rate meters.

The HC has a straight-line curve up to 300 per cent load and is not affected by temperature. While loads are building, it will measure the peaks as well as the valleys. Thus, without loss of revenue, it will bridge the gap to the final load which will require a larger meter.

SANGAMO

ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

For Balanced Insulation

LOOK FOR THE RED LINED CORE

YOU might as well use the best insulation as it costs no more. Irvington Balanced Insulations are the finest that can be made. For your protection, insist on the insulation with the Red Lined Core.

Since 1905, Irvington Varnished Cambrics have been leaders. Only the finest raw materials are used. The bleaching and finishing is done at our own plant. Our laboratories are constantly testing our products to insure the finest quality.

Irvington insulation lasts longer because of the seven factors of quality: High Resistance, Flexibility, Non-Hygroscopic, Heat Resisting, Chemically Neutral, Maximum Elasticity, High Dielectric Strength.

Irvington specializes in all insulation problems. Our technical staff is always glad to be of assistance in solving them for you. We will be pleased to submit samples and prices on request for any of our insulation lines.

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Representatives

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White Supply Co., St. Louis
E. M. Wolcott, Rochester
The Marwood Corporation, Portland, Oregon
Spokane, Washington
Seattle, Washington
Earl B. Beach, Pittsburgh, Pa.
Electric Insulation Co., Philadelphia, Pa.
Prehler Bros., Inc., Chicago
Prehler Bros., Inc., Cleveland
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IRVINGTON INSULATIONS THAT LAST!

VARNISHED CAMBRIC CANVAS
Black or Yellow
Straight or Bias
PAPER SILK DUCK

VARNISHED FLEXIBLE TUBING

"IRV-O-SLOT" INSULATION

"CELLULAK" LAMINATED TUBING

INSULATING VARNISHES

Always look for the Red Lined Core!

IRVINGTON INSULATION

IRVINGTON VARNISH & INSULATOR COMPANY
IRVINGTON, NEW JERSEY
Established 1905

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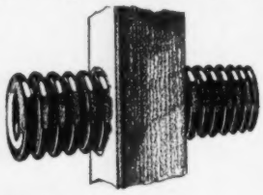
ELECTROSE
MARK
REG. U. S. PAT. OFF. & FOREIGN COUNTRIES



READY to serve you in our new plant with 50% greater floor space and the same high standards we have always maintained.

We can supply your demands for "Electrose," "Bakelite" and "Insulate" products. Send us your specifications.

Quotation cheerfully and promptly given.

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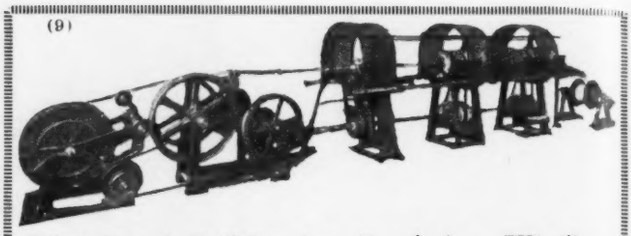

High-Speed Ball-Bearing Insulation Winding Machine

EST. 1885 AIMCo INC. 1915
"American" INSULATING MACHINERY COMPANY
REG. U.S. PAT. OFF.
519 Huntingdon St.
PHILADELPHIA PENNSYLVANIA U.S.A.

for applying two tapes from concentric rolls and a cotton binder. Machine has automatic stops for broken tapes or exhausted rolls of tape. Can be built for any number of tapes.

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Everything In Insulation

Compounds, Waxes & Paints
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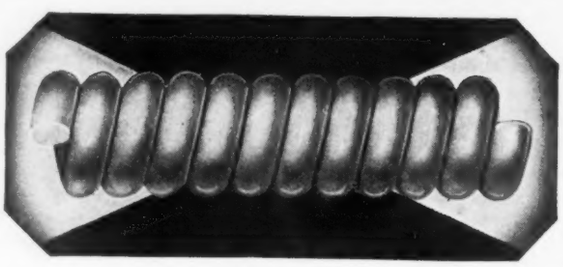

Galvanized Telephone Wire and Steel Strand

Crapo Galvanized Wire can be wrapped around its own diameter without injury to its pure zinc coating....That is one of a number of reasons why **Crapo** Galvanized Telephone Wire and Strand can be depended upon to reduce maintenance cost.

Look for the **Crapo** Seal!

Indiana Steel & Wire Co.
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For Switchboards, circuit breakers, compensators and similar electrical equipment Monson Slate is recognized as the best.

We have just completed additions to our producing facilities which provide for double our former capacity. Thus manufacturers of electrical apparatus are assured prompt attention and quick shipments.

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Giving radio voices a good send-off

To put their broadcasts "on the air" in a way that will do full justice to the entertainers' art, leading stations use Western Electric equipment. Thus they safeguard their reputation and your enjoyment.

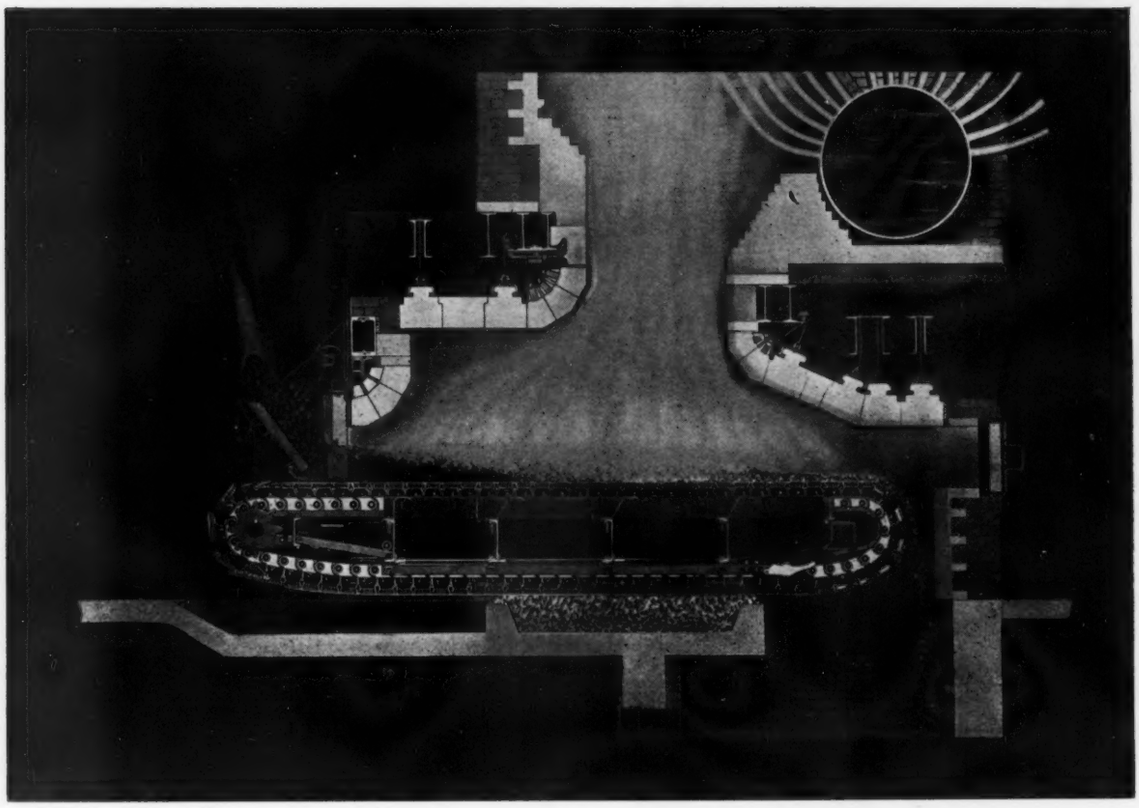
This Company's ability to make sound reproducing apparatus of outstanding quality and reliability is a natural outcome of its long experience in making Bell Telephones. The familiar microphone is the telephone's "little brother." This and many other radio developments have come from pioneering work in telephone research.

So, in providing equipment for broadcasting, for talking pictures, for voice amplification, for hearing aid, this organization keeps in step with changing needs. More and more the nation is getting its ideas through its ears, and in the field of sound Western Electric products occupy a commanding position.

Western Electric

Makers of your Bell telephone and leaders in the development of sound transmission

Western Electric Radio Telephone Broadcasting equipment is distributed by Graybar Electric Company.



THE HARRINGTON IS MASTER

in the realm of travelling grate stokers

This statement is based on incontestible operating facts. Of machines in any general classification, there is always one which stands out above the others. In the realm of travelling grate stokers, we are fortunate in having this be the Harrington Stoker.

Results which users are obtaining have placed the Harrington Stoker in this enviable position of leadership. Its sturdy strength, mechanical perfection, reliability and extraordinary performance ability stamp it as a leader. Its installation cuts down costs and increases profits.

The ability of Harrington Stokers to burn almost any type of fuel efficiently astonishes engineers. It is performing excellently with all fuels from anthracite to lignites. An investigation of its construction and its performance on the firing aisle shows many substantial reasons why it is so satisfactory in operation.

RILEY STOKER CORPORATION
WORCESTER, MASS., U. S. A.

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Anderson-Meyer & Co., China — International Machinery Co.; (W. B. Greer Co.) South America
American Trading Co., Japan — Fama—France, Italy, Holland, Belgium, Switzerland, Jugo-Slavia

for burning

ANTHRACITE

It's the HARRINGTON

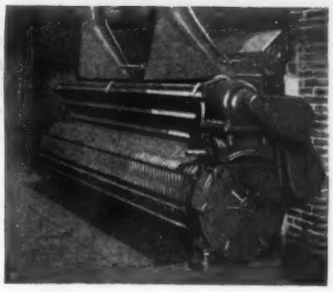
The Harrington burns all sizes of anthracite from No. 2 Buck to mine culm. At the Flintkote Company, Little Ferry, N. J., ratings over 300% are obtained. Efficiencies as high as 82% have been reached with a monthly overall efficiency of over 75%. Because of such results, there are many Harringtons in anthracite service.

A Few who use Harrington Stokers to burn Anthracite

Luzerne County Gas and Electric Co.
Armstrong Cork Co.
Consolidated Gas Co. of Baltimore
Flintkote Co.
Philadelphia Electric Co.
Glen Alden Coal Co.
Brooklyn Borough Gas Co.
Atlantic Refining Co.
Public Service Electric and Gas Co. of New Jersey
International Motor Co.
New York Belting and Packing Co.
Univ. of Pennsylvania
N. Y., Ont. and Western Railroad
Lehigh Valley Coal Co.

for burning

COKE BREEZE



It's the HARRINGTON

Practically all of the larger steel companies use Harrington Stokers for burning coke. You will also find many Harrington Stokers installed in gas plants. 20′ x 22′ Harringtons are operating 1608 H. P. boilers at the Interlake Iron Corp. at ratings over 250%. Carter White Lead reports monthly efficiencies between 75% and 81% with coke breeze.

A Few who use Harrington Stokers to burn Coke Breeze

Youngstown Sheet and Tube Co.
Carnegie Steel Co.
Detroit City Gas Co.
Illinois Steel Co.
Washington Gas Light Co.
Republic Steel Co.
Worcester Gas Light Co.
Grand Rapids Gas Light Co.
Tennessee Coal, Iron and Railroad Co.
Western United Gas and Electric Co.
Interlake Iron Corp.
Wilmington Gas Light Co.
Muskegon Gas Light Co.
Woodward Iron Co.

for burning

MID-WESTERN COALS

It's the HARRINGTON

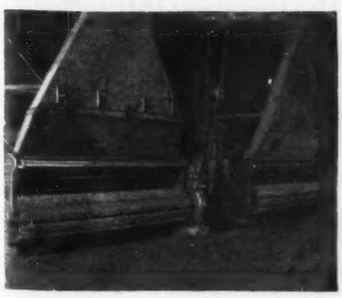
The Bear Brand Hosiery at Kankakee, Ill., uses three 10′ x 13′ Harringtons under three 600 H.P. boilers. They operate up to 300% of ratings with average monthly efficiencies of 78%. Standard Oil at Cleveland obtain similar satisfactory results. You will find many Harringtons burning Illinois, Iowa, Indiana, and Ohio coals.

A Few who use Harrington Stokers to burn Mid-western Coals

Cleveland Electric Illuminating Co.
Colonial Salt Co.
Standard Oil Co.
U. S. Gypsum Co.
Illinois Steel Co.
Bear Brand Hosiery Co.
Titanium Pigment Co.
American Can Co.
Agar Packing Co.
Northern Pacific Railroad
Great Northern Railroad
Pettibone Mulliken Co.
W. T. Rawleigh Co.

for burning

LIGNITE



It's the HARRINGTON

When it comes to lignite, the performance of Harrington Stokers places them in a class by themselves. Imagine burning 6000 B. T. U. North Dakota lignite with 40% moisture and operating boilers at 350% of rating with efficiencies well up in the seventies. But that is just what the Otter Tail Power Co. is doing. No wonder the Harrington is master in the Northwest.

A Few who use Harrington Stokers to burn Lignite

Northwestern Public Service Co.
Otter Tail Power Co.
Great Northern Railroad
Northern Pacific Railroad
Eastern Montana Power Co.
Fairmont Creamery Co.
North Dakota Agri. College
Gallup American Coal Co.
South Dakota State College
Pierre Municipal Plant
United Public Service Co.
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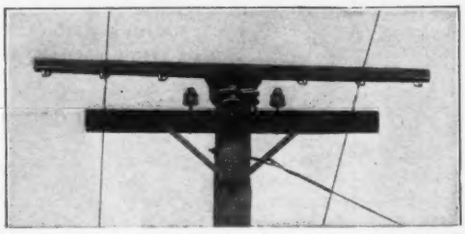
The Universal Tools

A device that will save you time and money.

A safe, sure, speedy way of loading trucks or pulling guy wires.

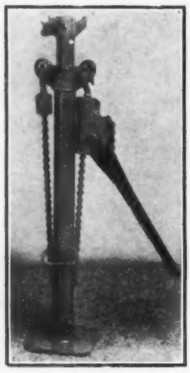
They can be used either end up or in any position, wherever a lift or pull is needed. You cannot afford to be without them in your construction work.

Sizes from ¾ to 6 ton; weight 14 to 65 lbs.; Price $34 to $95.

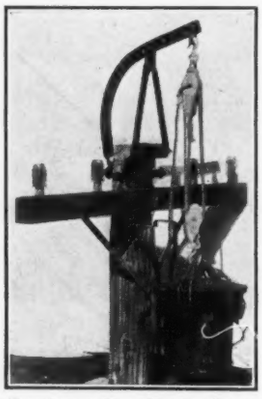


Temporary Crossarm and Clamp. They can be readily clamped to a pole above or between the crossarms. For changing crossarms on corners or on pole lines.

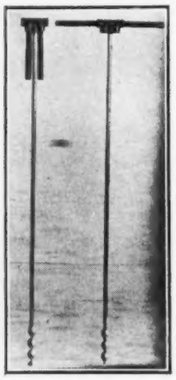
Flag and Flag Holder. For poles, pipes, etc., in transit. Can be easily attached and removed. Spring attached to chain so holder will not work loose.



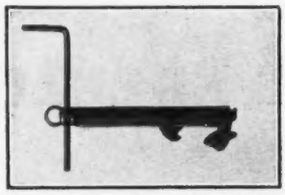
The Ideal Jack for pulling and straightening poles. It has tilt and swivel base.



Transformer Gin. Can be clamped securely to top of poles. For lifting transformers.



Ground Auger for temporary grounding in all kinds of earth. Easy to remove from the ground. Collapsible handle makes it compact. Easy to remove it under other tools.



Temporary Guy Clamp. For necking guy wires under heavy tension. 3 bolt clamp can be put in proper location without using hammer.

Any of this equipment can be secured on 30-days trial.

Catalogue with full information will be sent upon request.

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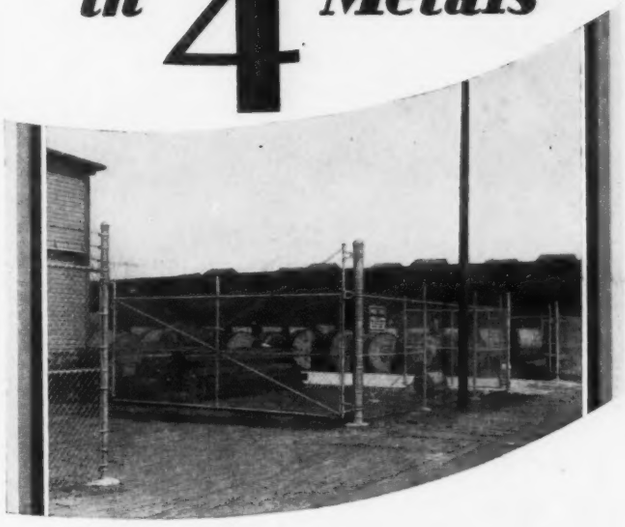

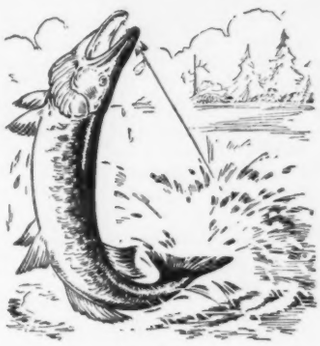

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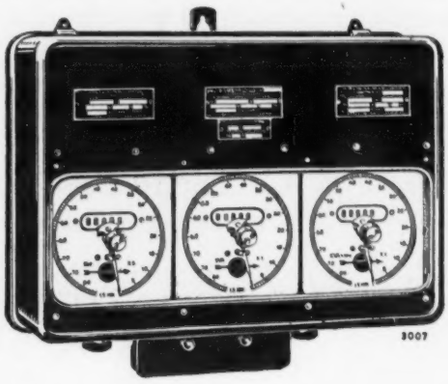

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KVA METER

If desired it will produce the integrated KW, KVA, and reactive KVA readings, as well as their demands for the complete lagging and leading power factor range.

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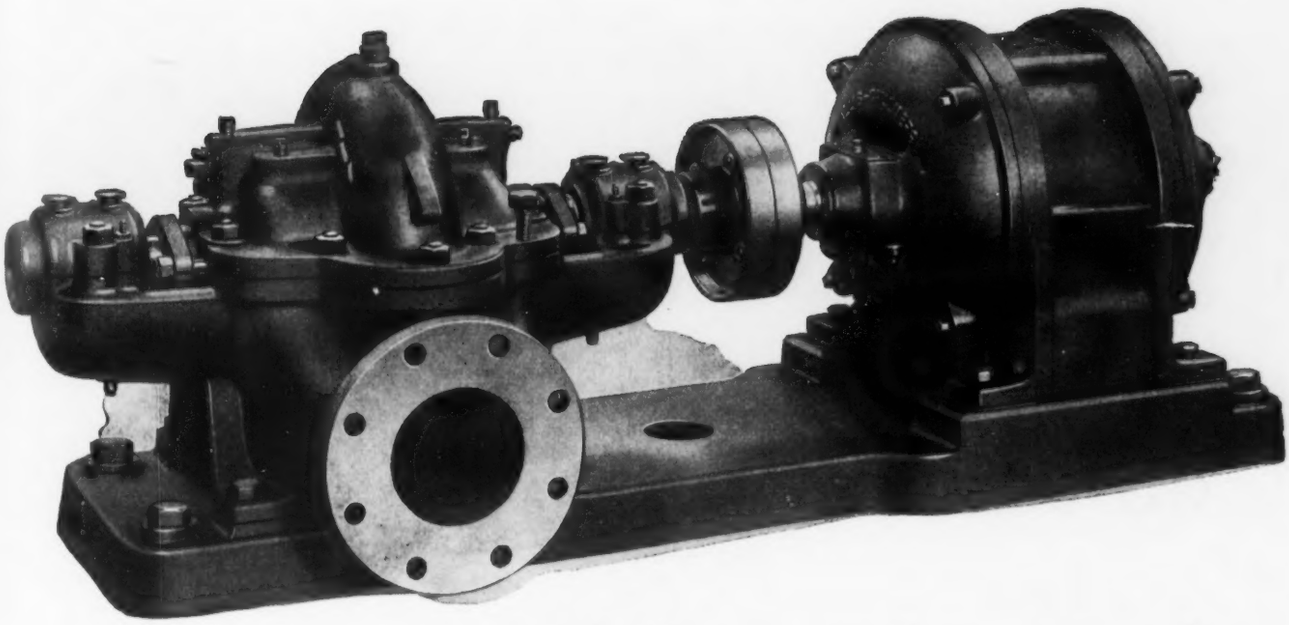
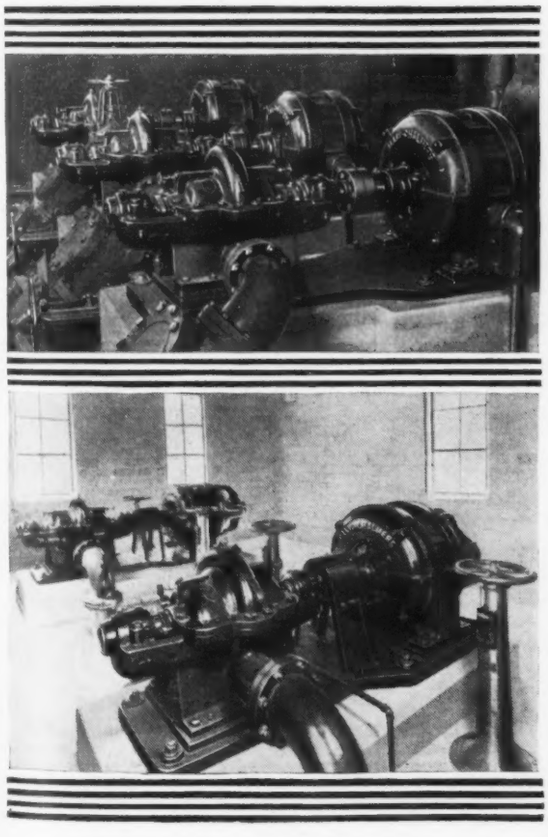


... a widely used unit *for* General Purpose Pumping



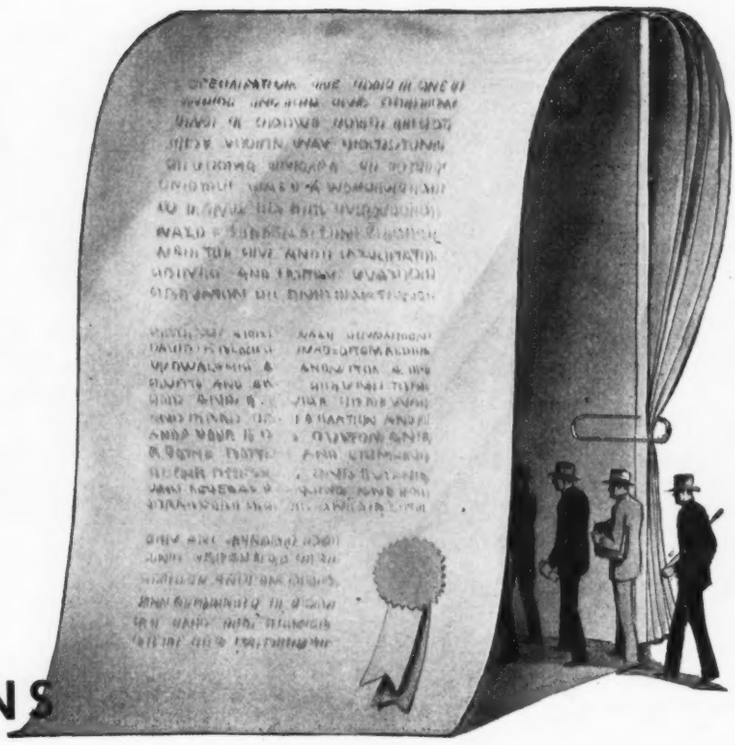
One of the most popular of the many types of Allis-Chalmers centrifugal pumping units is the type "S", for handling general pumping requirements. This is an improved double suction, split-casing, bronze fitted, horizontal shaft pump designed for long service and high efficiency at a reasonable cost.

Type "S" units, both pump and motor are built by one company and sold as combined units, give the most pumping value per dollar. All parts, including base plate, are taken from stock with the pump runner selected to meet the requirements for the particular service intended. Then the unit is tested for head, capacity, and efficiency.

Standard Type "S" Units are built in capacities from 30 to 30,000 g.p.m. and for heads up to 300 ft. These together with other types of single and multi-stage Allis-Chalmers pumps, so satisfactorily take care of most pumping requirements that it should pay you to write for our recommendations when considering pumping equipment.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee



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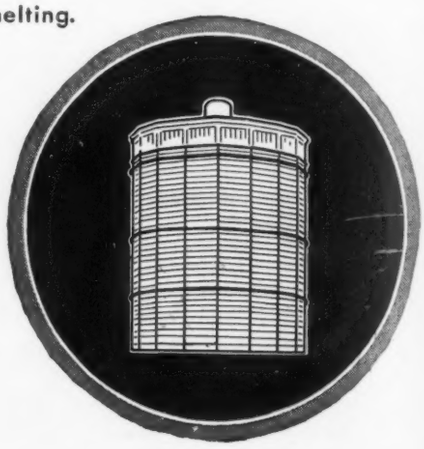

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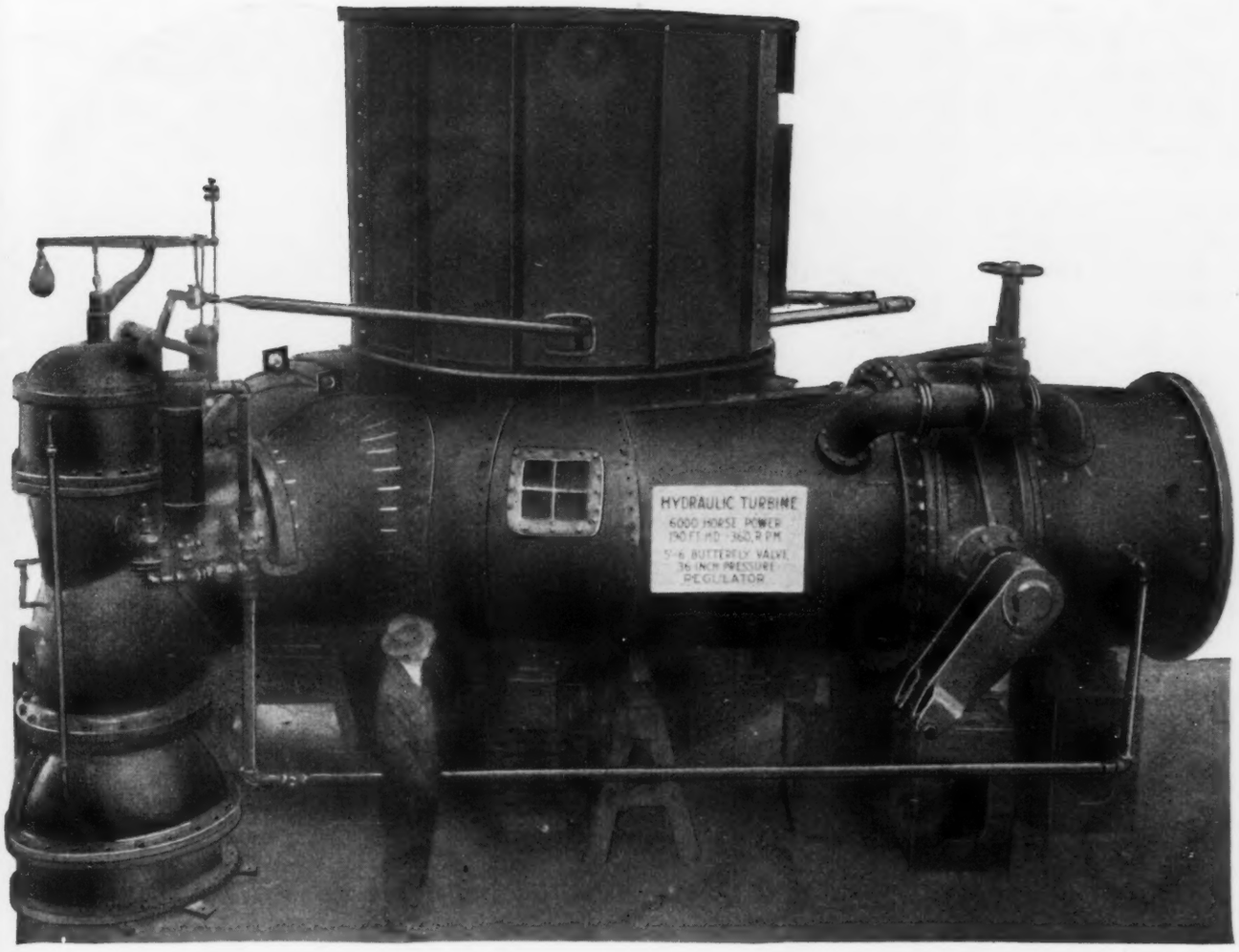

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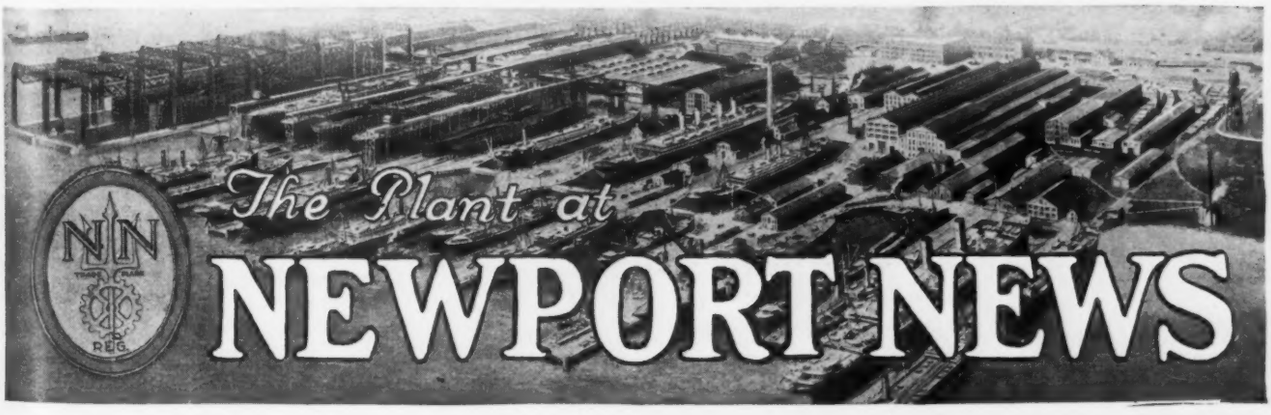

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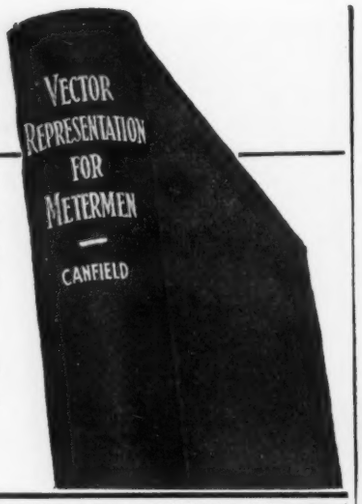

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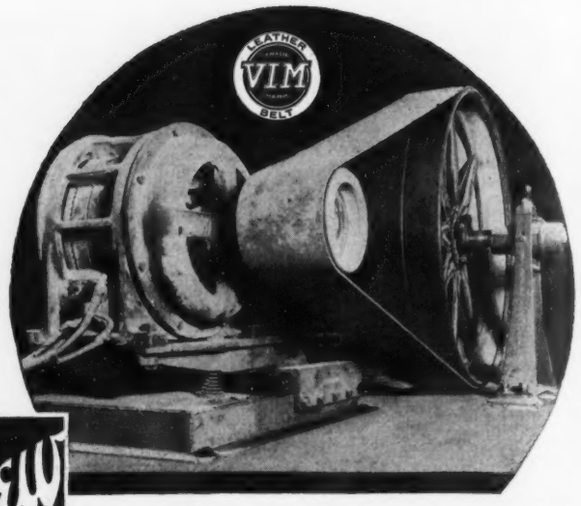

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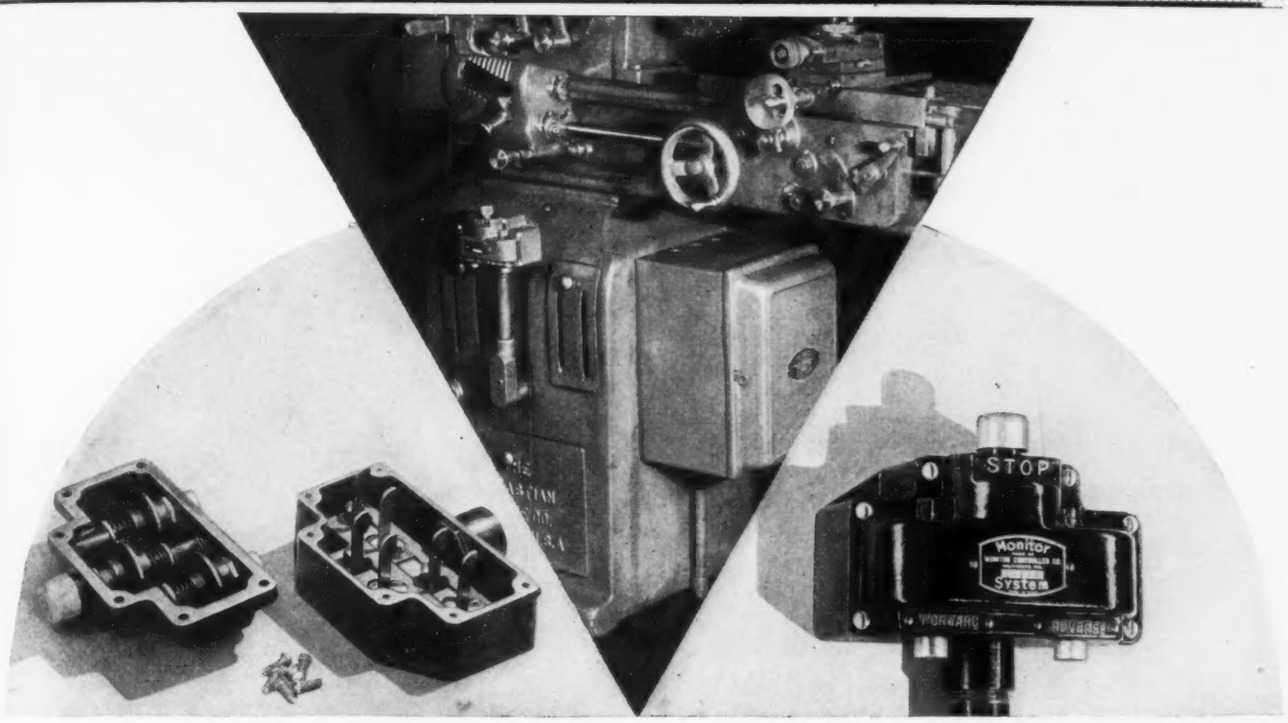

This tool-maker's lathe is equipped with a Monitor reversing controller and automatic braking for quick, accurate stopping and inching.

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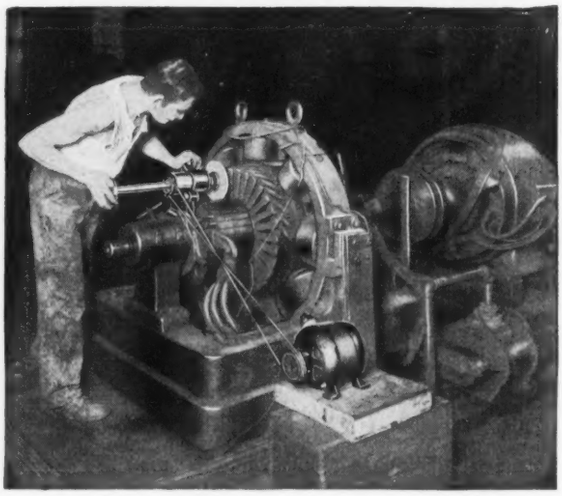

THIS illustration shows an Electro Plating machine 21 K.W., 3500 amp., 6 volt, 450 R.P.M., being trued with a Jordan Truing device. It cuts off a minimum of copper, prolonging the life of the armature, and it will not drag copper from bar to bar. The armature need not be removed—in fact the machine can go on delivering its full load while being trued.

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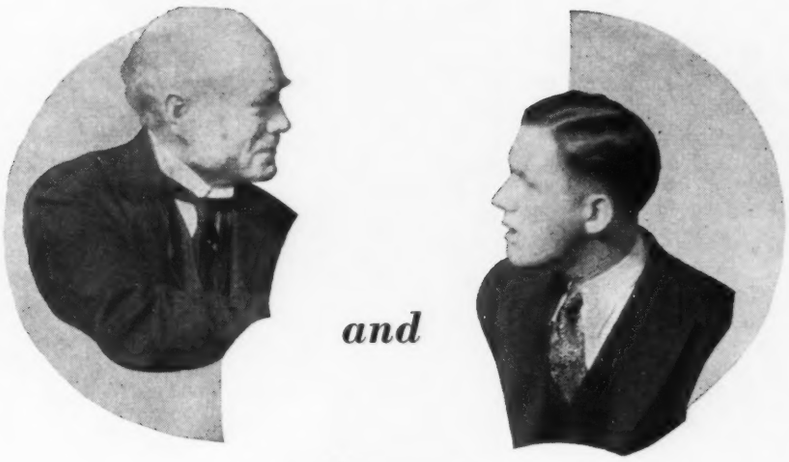

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(d) 72,000	55,400
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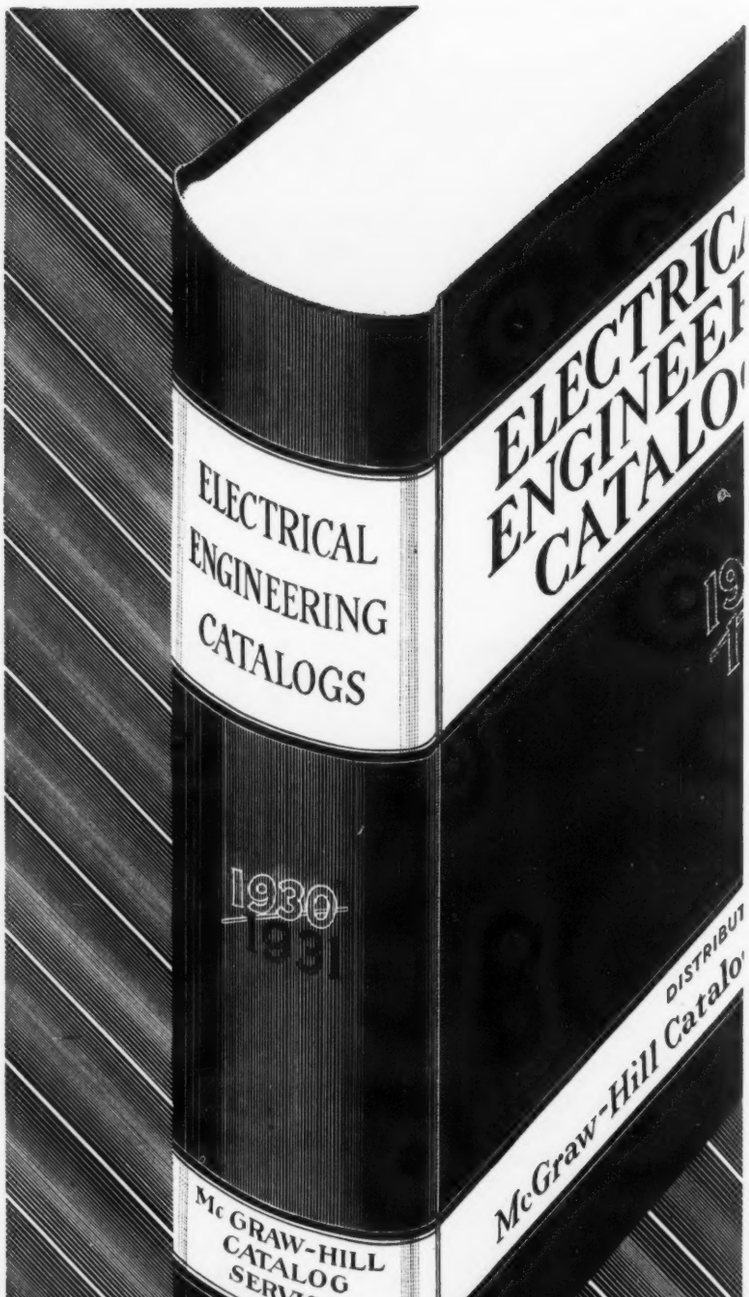

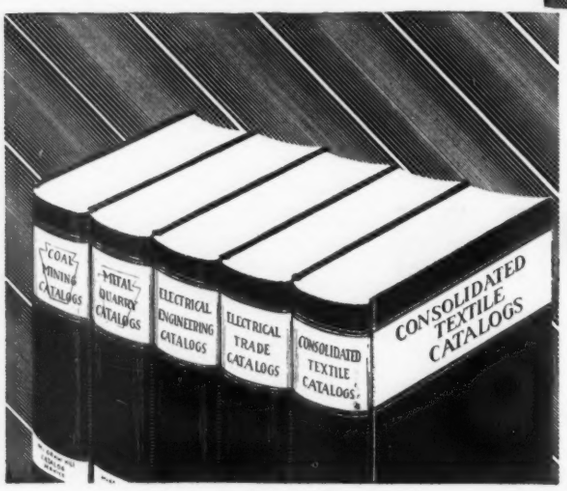

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2	125	900	2300	3	Cr.-Wh.
2	100	900	230-2300	3	G.E.
1	75	600	220	3	Westg.
1	75	900	2300	3	G.E.
1	50	1200	220-440-2300	3	G.E.

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2	300	600	445-2300	G.E. syn.
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1	250	600	440-2200	G.E. syn.
3	200	514	4150-2300	G.E. syn.
2	175	3 ph. 60 cy.		2300 volts, G.E.
4	150	1200	220/440	Westg. rg.
1	150	900	2300	G.E. syn.
2	150	514	2200	Westg. sl.rg.
1	150	1800	2200	Westg. sq.cg. mtr.
1	100	900	440-2200	G.E. sq. cg.
1	100	900	220-440-220	Westg. sq. cg.

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No.	*Kw.*	*R.p.m.*	*Volts*	*Type*
1	200	900	250	G.E.
1	200	600	250	G.E.
1	200	525	250	G.E.
2	150	1200	250	Cr.-Wheele
1	150	600	250	G.E.
2	150	1200	250	Westg., new
1	100	720	250	G.E.
1	75	450	250	Dieh

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No.	*Hp.*	*R.p.m.*	*Type*
1	250	550	G.E.
2	200	1150	Cr.-Wheeler
1	150	600	G.E.
3	150	850	Westg. SK, new
1	150	1100	Westg. SK.
1	125	550	Cr.-Wheeler
1	100	625	Westg. Type S

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No.	*Hp.*	*R.p.m.*	*Type*
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1	100	600	G.E.
1	80	600	G.E.

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150	2200-440-220	G. E.	514
150	220-440-550	G. E.	600
100	550	Westghse.	900
100	2200	Westghse	900
100	2200	G. E.	720
100	550	G. E.	720
100	440-220	G. E.	720
100	440-220	G. E.	900
75	440-220	G. E.	600
60	440-220	G. E.	720
50	440-220	Westghse.	720

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300	440	G. E.	225
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240	440-550	G. E.	600
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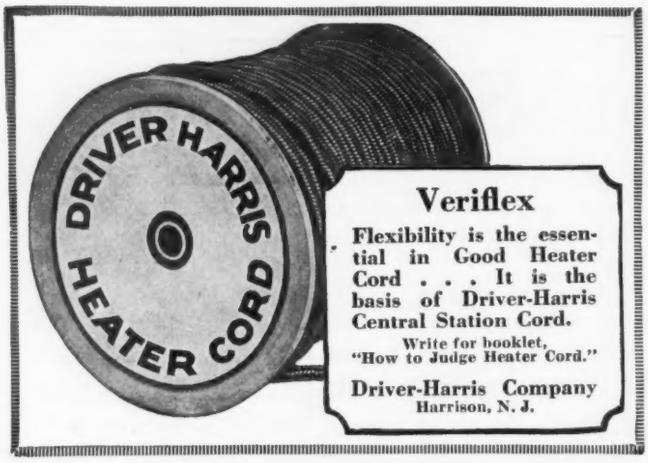

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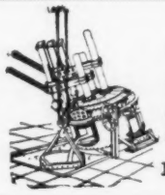

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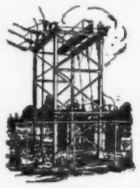

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